Attachment 2
Standard Operating Procedures

FIELD SAMPLING PLAN VOLUME 1 – version 2005-08-26
LOWER PASSAIC RIVER RESORATION PROJECT

ATTACHMENT 2 – Standard Operating Procedures

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Note SOP's 1, 2, and 3 are found in the Quality Assurance Project Plan (Malcolm Pirnie, 2005a)

Title: Procedure to Locate Sample Points Using a Global Positioning System (GPS)

I. Purpose

The purpose of this procedure is to provide reference information for the documentation of sample locations using a GPS at the Lower Passaic River Restoration Project Superfund Site.

II. Definitions

1. GPS - The GPS is a satellite-based positioning system, operated and controlled by the U.S. Department of Defense. The GPS includes 24 satellites, and can be used by anyone who has a GPS receiver. The GPS receiver is used for position determination, navigation, and survey tasks on land, sea, and in the air. The method of utilizing GPS varies with each application and the type of GPS equipment used. Operating methods range from low precision, code phase systems to highly accurate, carrier phase systems that facilitate on-the-fly measurements, also known as real-time kinematic surveying (RTK). The Lower Passaic River Restoration Project Superfund Site will use a hand held GPS receiver with sub meter horizontal accuracy to capture the coordinates of sample locations.

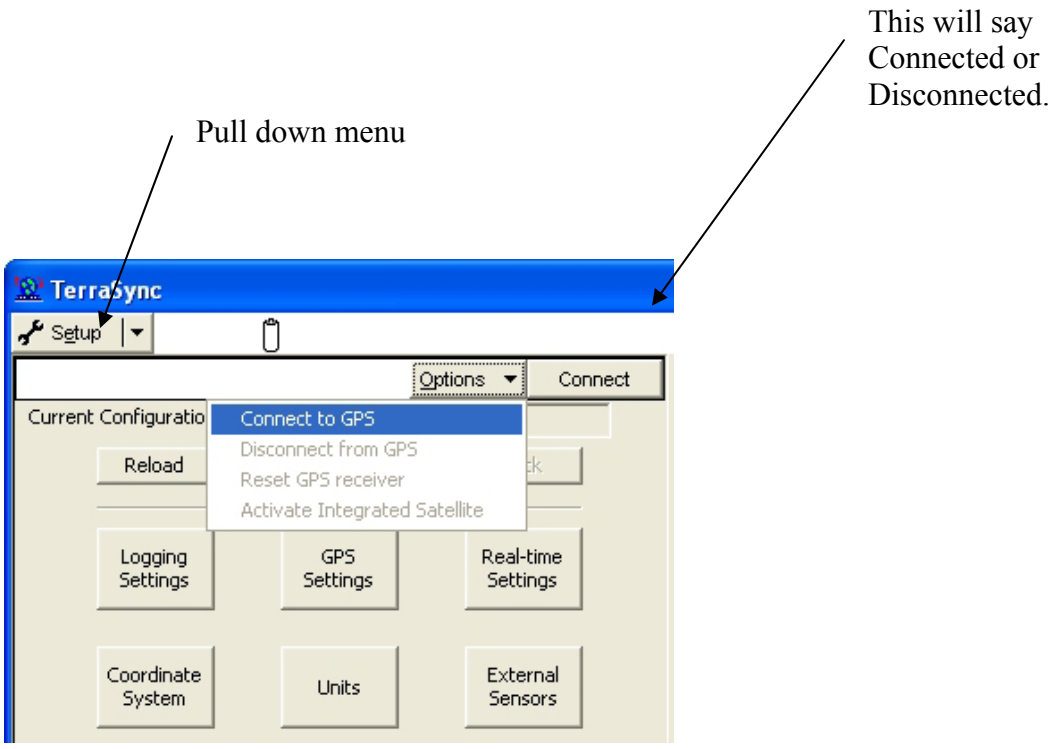
III. Equipment and Materials

1. Trimble Geo XT with related cable and power supply.

IV. Field Procedure

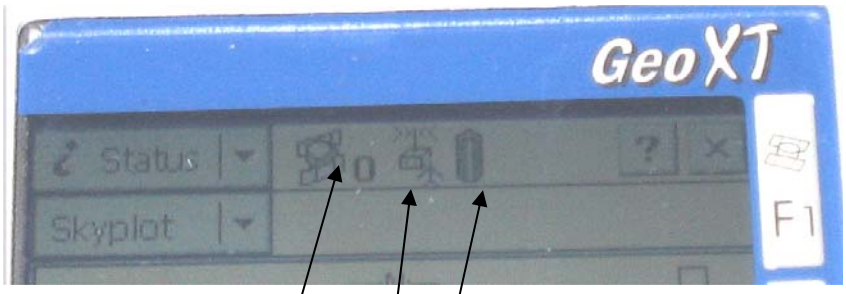
1. Getting Started

   A. Power up the unit by pressing the large gray button below the screen area and start the TerraSync application by selecting F1 or the Terra Sync icon. Wait about 5 minutes for the GPS unit to receive a new almanac and satellite information.
   B. Verify that the GPS unit is connected to the satellite network. After starting TerraSync, the status screen will appear, and will indicate if the GPS is connected or disconnected to the satellite network. If it is disconnected, use the stylus to click on the pull down menu in the upper left corner of the screen (see graphic below) and go to the Setup screen. Underneath the Setup pull down menu, select Options and select Connect to GPS.



2. Confirm Status of GPS

   A. The GeoXT will be collecting a new almanac and satellite readings. In the top tool bar you will see the number of satellites tracking, differential correction signal status, and the battery charge information. You must have 4 satellites available and the differential status must be on (i.e. the differential icon should not be blinking) to collect coordinate locations.



Satellites Tracking
Differential Correction Status
Battery Charge Indicator

3. Confirm the Coordinate System

   A. In the Setup menu choose Coordinate System
   B. On this screen you should see the following, or update entries to match:
      System = US State Plane 1983
      Zone = New Jersey 2900
      Altitude = Mean Sea Level (MSL)
      Altitude Units = Feet
      Geoid = DMA 10x10 (Global)
      Coordinate Units = Meters
      Display USNG = Off

4. Create a File

   A. From the pull down menu in the upper left corner choose Data
   B. Select the Dictionary Named Passaic and name the file using the input panel (if the input panel is not automatically present click on the icon in the lower right corner that looks like a key board)
   C. Click Create

5. Collecting Point Data

   A. Using the pull down menu choose Map (you can also collect data from the Data menu but you will not see where you are on the map).
   B. Click on the blue circle in the upper right corner of the screen enter the name of the sample you are taking as well as the matrix (sediment or water).
   C. You can insure you are collecting satellite data by seeing a pen and wavy line icon to the right of the main pull down menu. You will also see the number of data sets you have gathered, the number of satellites that you are collecting information from and the status of the differential correction.
   D. When you have collected more than 3 sets of data (indicated by the number next to the pen and wavy line icon) select OK.
   E. You should now see your collected data as a square with an X in it on the map.
   F. Move to you new location and repeat step 5 until you are finished.

6. Closing the data and shutting down

   A. When you are finished using the GPS unit shut the application down by clicking the X in the upper right corner of the screen.
   B. You will be asked if you are sure you want to do this. Click yes.
   C. Press the gray button at the bottom of the GeoXT and bring it back to the office for processing.

V. Quality Control

The GPS has quality control features that are built into the system. The system will not allow measurements to be taken if there are not enough satellites available to provide accurate readings, if the satellite geometry is not conducive to the survey, and for other reasons. The system maintains quality control records during a survey that contain information about the quality of the GPS position, including the number of available satellites, satellite geometry, and horizontal and vertical precision levels. These records can be accessed when the data is post processed in order to assure that the necessary quality standards are being achieved.

VI. Reference

TerraSync Operation Guide. Trimble Navigation Ltd., 2002.

Title: Procedure to Document Field Activities

I. Introduction

The purpose of this guide is to provide reference information regarding the documentation of field activities conducted at the Lower Passaic River Restoration Project Superfund Site.

II. Definitions

1. Field Data – Any and all information collected during activities at the site.

2. Electronic Field Data Form – A standardized electronic data form used for the collection of information and/or technical data during field activities.

III. Guidelines

The documentation of field activities at uncontrolled hazardous waste sites is governed by a variety of legal guidelines that must be understood prior to the commencement of field activities. It is imperative that the personnel who will be conducting the field activities understand how the overall constitutional, statutory, and evidentiary legal requirements apply to the site inspection documentation and to the rights of potentially responsible parties.

The description of and observations made during field activities often provide the basis for technical site evaluations and other related written reports. All electronic records and notes generated in the field will be considered controlled evidentiary documents and may be subject to scrutiny in litigation. Consequently, it is essential that the Field Team Leader pay attention to detail and document to the greatest extent practicable every aspect of the inspection.

Personnel designated as responsible for the documentation of field activities must be aware that all electronic notes taken may provide the basis for the preparation of responses to legal interrogatories.

Field documentation must provide sufficient information and data to enable the reconstruction of field activities. A wireless field application using standardized electronic data forms will provide the basic means for documenting field activities.

Control and maintenance of wireless field applications used in documentation of field activities is the responsibility of the Field Team Leader. If the person responsible for

documenting site inspection activities is someone other than the Field Team Leader, the transfer of responsibility must be documented.

1. Documentation of Field Activities

Electronic field entries must provide an unbiased, concise, and detailed description of all field activities. Step-by-step instructions and procedures for documenting field activities are provided below. They are organized by the following:

A. The first set of instructions and procedures provides general guidance relating to the format and technique in which electronic field entries are to be made. It is important that field activities are documented in the most organized, chronological manner possible.

B. The second set of instructions and procedures provide guidance on the type of information to be recorded when field activities are electronically documented. In general, the following information must be recorded:

i. The identities and affiliation of the personnel conducting field activities.

ii. A description of the type of field work being conducted (*e.g.,* water column sampling, sediment core collection, etc.) and the equipment used.

iii. The date and time the field activities were conducted, with specific temporal information for each task (*e.g.,* record the time activities commenced at each individual location, or when different types of activities commenced at the same location), if applicable.

iv. The site where the field activities were conducted, and also any individual location within that site where work was performed (*e.g.,* specific sampling sites).

v. The general methodology used to conduct the activities.

vi. Deviations from FSP or SOP and reason for change

C. Instruction and procedures relating to the format and technique in which electronic field entries are to be performed should conform to the following:

i. Each day field activities are conducted the date, time, site name, location, names of Malcolm Pirnie personnel and their responsibilities, and names of non-Malcolm Pirnie personnel into the field application. Any

deviations from the work plan that occur while field activities are being conducted must also be documented.

ii. All photos taken must be associated with field entries and all photo locations must be referenced on a site map. Information in the photo log must include the date, time, photographer, and a description.

iii. All entries must be made in language that is objective, factual, and free of personal feelings or other terminology that might prove inappropriate.

iv. All entries must be accompanied by the appropriate 24-hour clock time (such as 1530 instead of 3:30). A time and status entry is recommended every 30 minutes or less.

v. If the individual designated for field documentation tasks transfers those tasks to another team member, he or she must clearly document this transfer of responsibility through logging out and the newly designated field member log back in with their assigned login and password.

2. Sampling Activities

A chronological record of each sampling activity must be kept. During sampling, the data entry person will choose the appropriate survey that the sampling falls under (*i.e.,* large volume water column sampling, high resolution coring, *etc.*). The field application will automatically prompt the user for required data and attributes based on pre-programmed survey requirements. Be sure that all required fields are properly filled in or field application will not allow user to continue. Container IDs are pre-printed and need to be affixed and entered into the field application for every sample. After data entry is complete for the day user accesses the shipping module and designates which coolers contain which samples and to where the samples are to be shipped. The generated sample ID labels should be printed out and affixed to the appropriate sample container. Print out generated chain of custody to accompany samples in shipment.

IV. References

U.S. EPA-Characterization of Hazardous Waste Sites - A Methods Manual, Volume I - Site Investigations, April 1985:

USACE Requirements for the Preparation of Sampling and Analysis Plans, September 1, 1999

Title: Procedure for Decontaminating Soil Sampling Equipment

I. Introduction

This procedure describes the methods used to decontaminate soil sampling equipment and sample processing tools used at the Lower Passaic River Superfund Site. The procedures specifically address equipment used to collect sediment and soil samples.

II. Definitions

PPE-Personal Protective Equipment

III. Equipment and Supplies

The following equipment will be used to decontaminate equipment and tools used to collect sediment and soil samples:

1. Tap water for initial cleaning and rinsing of equipment.
2. De-ionized water for final rinsing of equipment after tap water or solvent rinse.
3. Non-phosphate detergent (*e.g.* Alconox™) for cleaning equipment.
4. Dishwashing detergent (*e.g.* Joy™ which provides suds in seawater) to remove oily or organic residue.
5. Nitric acid as a 10% solution for removing metal contaminants from equipment
6. Organic solvent for final cleaning of equipment (*e.g.* hexane)
7. Personnel protective equipment (PPE) - including disposable gloves (nitrile preferred), disposable wipes, eye wash system, first aid kit, and waterproof outerwear (if necessary).
8. Re-sealable buckets approved for waste collection and transportation.
9. Squirt bottles for water, alcohol, and solvents.
10. Brushes for cleaning equipment.
11. Field notebooks, pens, pencils, and digital camera to document decontamination procedures.

IV. Guidelines

The following equipment will be used to collect sediment cores and require decontamination:

1. Rotary drilling rig (truck-mounted or skid type) sampling equipment (e.g., split spoons). Large drilling equipment (*e.g.,* tri-cone bits, casing, augers, rods, etc.) will be steam-cleaned only.
2. Tripod drill – follow procedures for drill rig above.
3. Calibrated Steel Rod to investigate the sediment type and probe the depth of unconsolidated sediments at a sampling location and to determine the length of tubing to use.
4. Shelby tubes conforming to thin-walled tube specifications outlined in ASTM D 1587 with a 3-inch O.D.
5. Vibracorer and ancillary equipment.
6. Aluminum, Polycarbonate, Lexane, or Cellulose Acetate Butyrate (CAB) Tubing of appropriate diameter (approximately 3.75 inch O.D. and 0.07 inch wall thickness) for use with the vibracoring apparatus.
7. Sediment Grab Sampler (*e.g.,* Ponar, van Veen, Smith McIntire, or Eckman Grabs) used for surface sediment collection.
8. Stainless steel scoops, spoons, bowls, and other equipment that come into contact with the sample, are used for homogenization, or are used to segment core tubes.

Collection of sediment, soil, and water samples for chemical analysis requires that the equipment be cleaned between sample locations to avoid sample contamination. Generally, the cleaning procedures to be followed between sample locations are as follows:

Decontaminate all sample collection tools that contact the sample as well as all bowls and mixing/distribution implements in accordance with the following procedures.

1. Rinse each item with tap water to remove mud, dirt, or other visually present material.
2. Scrub the item with a brush and soapy water, using non-phosphate detergent such as Alconox™ for non-oily residue, or a detergent (*e.g.* Joy™) for items with oily or other sticky organic residue.
3. Rinse the item with tap water to remove all residual soap
4. Rinse the item with 10% nitric acid to remove residual metals
5. Rinse the item with de-ionized water
6. Rinse the item with organic solvent (*e.g.* hexane)
7. Rinse the item with de-ionized or analyte-free water and allow to air dry.

8. Wrap the item(s) in aluminum foil or plastic bag to protect it until it is used.

All solvents must be captured and disposed of in appropriate, labeled, aqueous waste containers. All instruments that come into contact with the sample (i.e. syringe, ruler, collection buckets) must be cleaned in the same manner as the sampling device. Liquids collected into the chemical waste container must be discarded in an appropriate waste stream. Staff performing decontamination procedures need to wear appropriate PPE, gloves (*e.g.* nitrile) and eye protection. Care must be taken in cleaning not to allow contact of cleaning solutions with clothing as much as possible. If circumstances dictate contact will occur (*e.g.* high pressure washing, splashing, high wind), waterproof outer clothing must be worn (*e.g.* foul weather gear or rain gear).

Decontamination procedures may vary depending on specific workplan specifications, and unique contaminants of concern at specific locations. The project workplan may designate collection of equipment rinse samples to document effectiveness of cleaning.

This SOP does not address radioactive decontamination, PPE for radioactive waste, or disposal of radioactive contaminated waste material.

IV. References

American Society for Testing and Materials (ASTM), 1994. Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites. Designation: D 5088 – 90.

Title: Decontamination of Water Sampling Equipment

I. Introduction

This procedure describes the methods used to decontaminate water sampling equipment and sample processing tools for the Lower Passaic River Restoration Project. The procedures specifically address equipment used to collect sediment samples.

II. Definitions

PPE - Personal Protective Equipment

III. Equipment and Supplies

The following equipment will be used to decontaminate equipment and tools used to collect water samples:

1. Tap water for initial cleaning and rinsing of equipment.
2. De-ionized water for final rinsing of equipment after tap water or solvent rinse.
3. Non-phosphate detergent (*e.g.*, Alconox™) for cleaning equipment.
4. Dishwashing detergent (*e.g.*, Joy™ which provides suds in seawater) to remove oily or organic residue.
5. Nitric acid as a 1% solution for removing metal contaminants from equipment
6. Isopropyl alcohol
7. Organic solvent for final cleaning of equipment (*e.g.*, hexane or equivalent)
8. Personnel protective equipment (PPE) - including disposable gloves (Nitrile preferred), disposable wipes, eye wash system, first aid kit, and waterproof outerwear (if necessary).
9. Re-sealable buckets approved for waste collection and transportation.
10. Squirt bottles for water, alcohol, and solvents.
11. Brushes for cleaning equipment.
12. Field notebooks, pens, pencils, and digital camera to document decontamination procedures.

IV. Guidelines

The following equipment will be used to collect water samples and require decontamination:

1. Infiltrex 300 Trace Organic Sampler: Pump, integral piping and other surfaces associated with the Infiltrex 300 Trace Organic Sampler's operation.
2. 5L Niskin bottles or equivalent.
3. Stainless Steel pressurized POP Canister
4. Vapor traps
5. Plastic tubing
6. Funnels
7. Graded cylinders
8. Graded tools used to measure river depth
9. Other equipment that comes into contact with the sample (*e.g.*, buckets, etc.).

Collection of water for laboratory analysis requires that the equipment be cleaned between sample locations to avoid sample contamination. Generally, the cleaning procedures to be followed between sample locations are as follows:

Decontamination: all sample collection tools that contact the sample as well as all bowls and mixing/distribution implements in accordance with the following procedures.

1. Disassemble item (except for Stainless Steel POP bottles and 5L Niskin or equivalent bottles at this stage).
2. Rinse each item with tap water.
3. For Stainless Steel POP Canister and 5L Niskin bottles (or equivalent): pour approximately 1 liter of non-phosphate detergent such as Alconox™ and lay on its side for at least 2 hours (roll the canister periodically to contact all interior surfaces.
4. Scrub the item with a brush and soapy water, using non-phosphate detergent such as Alconox™ for non-oily residue, or a detergent (*e.g.*, Joy™) for items with oily or other sticky organic residue. Prior to scrubbing, disassemble stainless steel containers, 5L Niskin bottles or equivalent, etc. Be sure to scrub the inside of canisters, bottles, etc. (inside and out), threads, cover bucket, etc. Soak stainless steel containers, 5L Niskin bottles or equivalent, etc. for 30 minutes to 1 hour; roll bottle frequently.
5. During the scrubbing process, be sure to bleed Alconox™ solution or equivalent through small passageways/nozzles/vents, etc.
6. Rinse the item with tap water to remove all residual soap. Be sure to bleed tap water through small passageways/nozzles/vents, etc.

7. Rinse the item with 10% nitric acid to remove residual metals. Be sure to bleed 10% nitric acid through small passageways/nozzles/vents, etc.
8. Rinse the item with de-ionized water. Be sure to bleed de-ionized water through small passageways/nozzles/vents, etc.
9. Rinse the item with isopropyl alcohol. Be sure to bleed isopropyl alcohol through small passageways/nozzles/vents, etc.
10. Rinse the item with de-ionized water. Be sure to bleed de-ionized water through small passageways/nozzles/vents, etc.
11. Rinse the item with organic solvent (*e.g.*, hexane or equivalent). Be sure to bleed organic solvent through small passageways/nozzles/vents, etc.
12. Rinse the item with de-ionized or analyte-free water and allow to air dry. Be sure to bleed de-ionized or analyte-free water through small passageways, nozzles, vents, etc.
13. Re-assemble item(s).
14. Wrap the item(s) in aluminum foil or plastic bag to protect it until it is used.

All solvents must be captured and disposed of in appropriate, labeled, aqueous waste containers. All instruments that come into contact with the sample water must be cleaned in the same manner as the sampling device. Liquids collected into the chemical waste container must be discarded in an appropriate waste stream. Staff performing decontamination procedures need to wear appropriate PPE, gloves (*e.g.*, Nitrile) and eye protection. Care must be taken in cleaning not to allow contact of cleaning solutions with clothing as much as possible. If circumstances dictate contact will occur (*e.g.*, splashing, high wind), waterproof outer clothing must be worn (*e.g.*, foul weather gear or rain gear).

Decontamination procedures may vary depending on specific Field Sampling Plan specifications, and unique contaminants of concern at specific locations. The project workplan may designate collection of equipment rinse samples to document effectiveness of cleaning.

This SOP does not address radioactive decontamination, PPE for radioactive waste, or disposal of radioactive contaminated waste material.

V. Reference

American Society for Testing and Materials (ASTM), 1994. Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites. Designation: D 5088 – 90.

Title: Procedure for Sediment Probing

I. Introduction

This procedure describes the equipment and methods to be used to conduct sediment probing at the Lower Passaic River Restoration Site. This procedure specifically addresses probing the sediment at each core sampling location to determine the approximate sediment thickness and general sediment type.

II. Equipment and Supplies

The following equipment will be needed to conduct sediment probing:

1. Calibrated Steel Rod to investigate the sediment type, probe the thickness of unconsolidated sediments at each core sampling location, and to determine the length of core tubing to use.
2. Personnel protective equipment (PPE) - including hard hat, steel toe boots, and disposable gloves. (refer to HASP for full PPE requirements).
3. Log sheets to record all field collected data.

III. Guidelines

1. Using the on-board RTK DGPS system, maneuver the sampling vessel to within 10 ft (maximum distance) of the pre-programmed target coordinates for each core sample location, and stabilize the vessel as much as possible.

   Confirm the location by examining the site map, bathymetric survey map, and landmarks.

2. Use a calibrated steel rod to probe the sediment. The probe should be sharpened at one end, and be calibrated at specific interval (*e.g.*, 6 inches).

3. Probing should be conducted 3 to 5 feet away from the sampling location to avoid disturbance of the sediment where the sample will be collected.

4. Push the sharpened end of the probe into the river bed, taking note of the depth of penetration and the type of resistance encountered. Use both hands and hold arms close to the chest to advance the probe vigorously when determining the depth extent of the unconsolidated layer.

5. When initial probe is complete, move the probe laterally and repeat the above probing step three or more times. Maintain the minimum three foot distance from the sampling location.

6. Record the average sediment thickness encountered (to the nearest 6 inches) and estimated sediment type (see guidance below) in the field log and the field application.

   A. Bedrock refusal will have a distinctive "clink" and there will be no penetration.
   B. Gravel or cobbles on top of the bedrock surface will produce multiple clinkings and the probe strikes the larger rock particles.
   C. Sandy material will have a gritty or granular feel and will make a muted, raspy sound as the probe penetrates. There will generally be some resistance to probing, and that will increase with the depth of penetration.
   D. Silty material will be smoother and will probably allow the greatest penetration. The probe will smoothly move through silts and will make little or no sound.
   E. Clay will allow for a smooth penetration, but will be "stickier" than silt and will not allow as much penetration.
   F. Sometimes finer materials will adhere to the probing rod and will allow for verification by pulling the rod out of the water.

7. If the probing results are inconsistent between the three locations, record the estimated sediment type as that which is the most representative of the three probes, and note the inconsistency in the field log and the field application.

IV. Reference

Memo: Sediment Probing Oversight Guidelines; Hudson River PCBs Superfund Site. Dave Scheuing, TAMS. September 2004.

Title: Vibracoring – Collecting High and Low Resolution Cores

I. Introduction

This procedure describes the equipment and methods to be used to collect sediment cores for the Lower Passaic River Restoration Project. This procedure specifically addresses collection of sediment cores via vibracoring, which is expected to be employed during the High Resolution and Low Resolution Coring Programs.

II. Equipment and Supplies

The following equipment will be needed to collect sediment cores:

1. Sampling Boat capable of deploying vibracoring apparatus and with sufficient room for all vibracoring operations (*i.e.*, core tube and equipment storage, lay down area, and working space). Sampling boat must also be properly sized to operate in the typical water depths and conditions anticipated at the project site.

2. Calibrated Steel Rod to investigate the sediment type, probe the depth of unconsolidated sediments at a sampling location, and determine the length of core tubing to use (refer to SOP-8).

3. P3 Vibracorer, or equivalent, and ancillary equipment required for use.

4. Lexan Tubing of appropriate diameter (approximately 4.00 inch O.D.) and wall thickness for use with the vibracoring apparatus.

5. Core Barrel of appropriate diameter (capable of securing a 4 inch O.D. tube) and wall thickness for use with the vibracoring apparatus and Lexan Tubing. Alternately, aluminum coring tubes may be used in lieu of Lexan core tubes and core barrels, if necessitated by sampling conditions.

6. Ponar Dredge to use at locations where core samples cannot be collected (e.g., due to shallow sediment depth or other coring difficulties).

7. Personal protective equipment (PPE) - including hard hat, steel toe boots, tyvek suits, life vests, safety glasses, ear plugs/muffs, and disposable gloves. (refer to HASP Core Document and Addenda for full PPE/chemical-resistant clothing requirements).

8. Power Source for electronic equipment (*e.g.*, laptop computer, printer) equipped with GFCIs.

9. Miscellaneous Supplies – Core caps, 3M Scotch Super 33+ water resistant electrical tape, aluminum pans with lids, coolers, ice, saw for cutting tubing, five gallon buckets with lids, plastic garbage bags (large and small), rope, tarps (and/or insulating blankets) decontamination supplies, measuring tapes, scales, field books, pens, pencils, permanent markers, digital camera, laptop computer, printer, field application, and DGPS.

III. Core Collection Procedure

1. All data from sediment core collection activities will be recorded in the laptop-based field application on the sampling vessel. Upon completion of sampling at one location, all data obtained during core collection will be entered into the field application. Blank field log sheets that can be used to record information manually also will be provided in case of difficulties with data entry or equipment. Any manually recorded data will be transcribed into the field application at the end of each day.

2. If the water in a location is too shallow for the sampling vessel to navigate, the sample will be collected using hand coring techniques (see SOP 13). If the location is reached by wading, the DGPS antenna will be hand carried to determine the coordinates of the actual sampling location.

3. Using the on-board GPS system, maneuver the sampling vessel to within10 ft (maximum distance) of the preprogrammed target coordinates for each sample location and stabilize the vessel as necessary, using anchors or spuds.

    - Confirm the location by examining the site map, bathymetry survey, and landmarks.
    - Record the following in the field application:

        1. Date
        2. Sample ID
        3. Target Location
        4. Water Depth
        5. Tide Stage
        6. Time
        7. Weather Conditions

- The GPS unit should be mounted as close as practicable to the vibracore deployment to identify the core location as accurately as possible.

4. Don personal protective equipment in accordance with the HASP Core Document and Addenda.

5. Use a calibrated steel rod to probe the sediment surface to determine the sediment thickness and type in accordance with the Sediment Probing SOP-8.

   - If the estimated sediment thickness in the probing area is greater than 6 inches, record the probing information in the field application and attempt to collect a core using the vibracorer.
   - If the estimated sediment thickness at the probing are is less than 6 inches, additional probing of the sediment area will be conducted within 3 ft of the target location for deeper sediments. If thicker sediment deposits are found, relocate the boat to the new coordinates and attempt to collect a core. If no deeper sediment deposits are encountered, a sediment grab sample may be collected using a ponar dredge.

6. Record the probing depth and sediment description in the field application.

7. Clean the core barrel with a wash down pump, pressure washer, or steam cleaner as appropriate. Because of the direct contact with sample material, the core nose catcher assembly should be carefully decontaminated in accordance with SOP-6.

8. The Vibracoring Subcontractor will mount a clean, decontaminated clear plastic coring tube liner within the vibratory coring apparatus.

   - The core liner and core catcher, etc. will be assembled and attached to the vibracorer head as per manufacturer's instructions. Note: Core catchers shall be avoided where possible. The field team leader will be consulted on the use of core catchers on a location by location basis.
   - The rigid liner and core tube are to be seated securely in the vibracore "chuck" or head. The check valve must have a tight seal and be free of debris. [Note: in the case of consistent poor recovery, the Vibracoring Subcontractor should be directed to examine the check valve and clean or replace, if necessary.] The driller will not be reimbursed for unsuccessful cores (sediment that drops from the core due to poor check valve operation or other equipment failure.)
   - The vibracore apparatus will be attached to the end of a cable to so that it can be winched/lowered to the river bottom.

9. The Vibracoring Subcontractor will lower the coring apparatus, with the core tube attached, slowly and vertically through the water column, until the river bottom is reached. When the nose reaches the river bottom, the vibracore unit will be turned on. Note the start time. Do not permit the Vibracoring Subcontractor to advance the core tube into the sediment under its own weight before activating the vibracoring apparatus, but the core tube should be lowered slowly and allowed to contact the sediment prior to turning on the unit, to avoid disturbing fine-grained surficial sediments.

10. The Vibracoring Subcontractor will advance the core into the sediment until either the desired depth or refusal is encountered. Refusal is defined as the depth at which no additional penetration can be achieved in a one-minute period. Measure and record the depth of core tube penetration into the sediments in the field application.

11. The Vibracoring Subcontractor will turn off the apparatus and allow the core to settle for approximately 5 minutes.

12. The Vibracore subcontractor will pull the core upward out of the river bottom (using a winch as needed) and raise it to the surface. If the corer refuses to come free, the unit should be vibrated until it is extractable. The apparatus must be maintained in a vertical position during ascent to the surface and all subsequent handling through sediment core processing. Vibrating the core while it is being removed should be avoided as much as possible since sample may be lost from the bottom of the core and the entire core may need to be rejected as a successful core by the field team leader.

13. As the core is being retracted, before the bottom of the core tube breaks the water surface, the Vibracore Subcontractor is to place a cap on the bottom of the tube to prevent the loss of material from the core tube and affix the cap with 3M Scotch Super 33+ water resistant electrical tape.

14. Remove the core tube liner from the coring apparatus following the manufacturer's instructions. The core must be maintained in a vertical position during removal.

15. Estimate the recovered length of the sediment core and note it in the field application.

    - The length of the recovered sediment core will be measured directly within the recovered core tube. If necessary, a decontaminated stainless steel rule

with a "foot" to probe for the sediment surface from the top of the tube may be inserted into the top of the core tube to "feel" the surface and locate the top of the core.

- The distance between the top of the sediment in the core tube and the bottom of the coring tube corresponds to the estimated length of the recovered core.

16. Compare the length of the recovered core with the core penetration depth to calculate the percent recovery, and assess the core.

    - The following recovery criteria are to be met for low resolution cores: the recovered length of the sediment core must be more than 75% of the penetration depth and the core has less than 10% void space.
    - The following recovery criteria are to be met for high resolution cores: the recovered length of the sediment core must be more than 85% of the penetration depth and the core must be as free of voids as is possible.
    - If an insufficient amount of material is recovered, or if the core contains voids that are greater than one inch per foot of core length, cap the top and put the core tube aside while additional attempts are made to meet recovery goals (see below). If a compliant core is obtained, discard the non-compliant core into a re-sealable 5-gallon pail and store for subsequent IDW disposal.
    - An additional attempt will be made at a minimum distance of 1ft from previously attempted locations, and should have a penetration at least 6 inches deeper than the previous attempt, if feasible (e.g., refusal or the maximum penetration for the tube length was not reached). A maximum of three attempts to collect a core will be made for a given location ID.
    - Rinse the core tubes with site water between consecutive attempts, collecting all rinsate and discarded sediment for appropriate disposal.
    - If all three attempts to collect a core are unsuccessful based on recovery alone (*i.e.*, less than target % recovery, or unacceptable void space), retain the "best" (least voids/highest percent recovery) core for analysis and put a flag in the field application that indicates that the targeted recovery was not achieved.
    - If no recovery is consistently obtained, collect a ponar dredge sediment grab sample and note conditions preventing core collection in the field database.

17. Seal the top of the core tube with a cap and duct tape, and rinse the outside of the tube with river water.

18. After a successful core recovery, enter prompted information into the field application:

    - Time of recovery
    - Actual coordinates of the sample location
    - Core tube material (*e.g.*, Lexan®)
    - Core penetration depth (inches) (if not recorded earlier)
    - Core percent recovery
    - Observations, including probing results (if not recorded earlier)

19. Draw an arrow on the core tube with permanent marker to mark the top of the core. Using permanent marker, label the core with the sample ID, date, time, and recovery. If available, core labels will be completed and affixed to the core tube with the electrical tape.

20. Store the core vertically, either in a core tube cooler on ice (if available), or in a tall garbage can filled with ice. Lash core tubes securely to the railing of the vessel in a low traffic area. Use a thermal reflective tarp to keep the cores in the dark until they are transported to the field processing facility, if available.

21. If long cores are collected the cores may need to be cut prior to moving the vessel. The core may be cut using a decontaminated saw blade attached to a reciprocating saw. Once the Lexan is cut a decontaminated flat blade will be inserted into the core to prevent the core from slipping out. The core segment will be capped, labeled, and taped secure. For cores collected in aluminum tubes a pipe cutter will be used to cut the core tube.

22. At locations where core samples cannot be collected, grab samples will be collected. Lower a ponar dredge until it comes in contact with the sediment, which should trigger the release mechanism. Retrieve the ponar dredge and empty the contents into a new aluminum pan. Repeat the above steps until sufficient material is obtained (about 3 tries). Seal container with lid and tape. Label the container with permanent marker indicating sample ID, date, and time. Place aluminum pan on ice in a cooler.

23. Decontaminate the ponar dredge, if used, according to the SOP-6.

24. At the end of each day, the processing laboratory coordinator will access the coring information via the project website to prepare for subsequent core processing. Additionally, a hard copy of the field application will be printed out. The hard copy will serve as a back-up to the electronic copy, as well as the chain

of custody form from the field to the processing laboratory. This form will be signed by sample collection personnel and core processing personnel at the time that the core processing personnel take custody of the cores.

IV. References

Passaic River Dredging Pilot Study Quality Assurance Project Plan, Revision 1. June 4, 2004.

Title: Split Spoon Sample Collection

I. Introduction

This procedure describes the equipment and methods to be used to collect split spoon sediment samples for the Lower Passaic River Restoration Project. This procedure specifically addresses the collection of split spoon sediment samples using a rotary drilling rig or a sediment coring vessel equipped to advance casing and split spoons.

II. Equipment and Supplies

The following equipment will be needed to collect split spoon samples:

1. Drilling Barge: capable of securing at least one drill rig (truck, skid, or tripod) with sufficient room for all drilling operations (*e.g.*, mud tub, drilling equipment footprint, laydown area, working space). Sufficient room must also be available for storage of collected sediment samples and undisturbed samples (*e.g.*, Shelby tubes). Barge must also be properly sized to operate in the typical water depths and conditions anticipated at the project site. Some sediment coring vessels are also equipped to advance split spoons and casing.

2. Rotary Drilling Rig (truck-mounted or skid type): with all associated drilling equipment.

3. Tripod Drill and all associated drilling equipment for use in areas where site access is limited (*e.g.*, slopes or edge of shoreline).

4. Shelby Tubes conforming to thin-walled tube specifications outlined in ASTM D 1587 with a 3-inch O.D. Wax and end caps will also be provided for proper field sealing.

5. Casing: The borings will be cased, where appropriate, with pipe or other approved materials to allow for undisturbed soil sampling and rock coring. The casing will have a minimum diameter of 4 inches.

6. Drill Bits: Tri-cone roller bit and/or drag bits that deflect the circulating drilling fluid horizontally will be used to advance the bits through the sediment soils. The bits must be appropriately sized to ensure adequate installation of casing.

7. Bentonite/Portland Cement: Cement Grout mixture as approved by the Engineer.

8. Personnel protective equipment (PPE): including hard hat, steel toes boots, safety glasses, ear plugs, and disposable gloves.

9. Miscellaneous Supplies – Sample jars, five gallon buckets with lids, garbage bags (large and small), decontamination supplies, measuring tapes, scales, field books, pens, pencils, and pavement markers, digital camera, field application equipment, and GPS.

III. Guidelines

1. Using drill rig hammer or equivalent hammering device, set outer casing approximately 5 feet into river floor sediment. Outer casing should be directed through "moon-hole" or equivalent attachment structure on the drilling platform of the barge. This casing will help prevent river water from entering the boring, and prevent drilling mud from spreading across the river floor. Make sure barge is properly anchored or barge feet are properly set in place so that casing does not move from its original position.

2. Position drilling mud-tub to the drilling platform such that the mud-tub's inlet will receive drilling fluid circulation from the casing.

3. For collection of geotechnical samples via a rotary drill rig on a sampling barge, collect split spoon sediment samples via standard penetration test procedure ASTM D 1586 and undisturbed samples via thin-walled tube sampling ASTM D 1587. Conform generally to the above-referenced guidelines when using a variant of this equipment such as may be available on other sediment sampling vessels.

4. After drilling activities are complete, pump drilling fluids out of casing.

5. Grout borehole from the bottom-up with the engineer's-specified mixture of bentonite and Portland cement.

6. Pull casing from borehole.

7. Decontaminate split spoons, casing, etc. in accordance with SOP-6.

8. Containerize and dispose of Investigation Derived Waste (IDW) drilling fluids, and decontamination fluids in conformance with SOP-22.

9. Complete boring logs on the attached HTRW Drilling Log.

10. At the end of each day, the processing laboratory coordinator will access the information recorded for each split spoon sample collected via the project website. Additionally, a hard copy of the field application will be printed out. The hard copy will serve as a back-up to the electronic copy.

IV. References

ASTM D1586-99 Standard Test Methods for Penetration Test and Split-Barrel Sampling of Soils

ASTM D1587-00 Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes

Title: Core Processing – High Resolution

I. Introduction

This standard operating procedure (SOP) describes the process for handling, evaluating, segmenting, and sampling high resolution sediment cores for measurement of physical parameters and chemical, radionuclide, and geotechnical analyses. This processing procedure applies to sediment cores collected using several potential collection methods, including vibracoring, hand or gravity coring, and advancing split spoons and casing. High resolution cores are those cores segmented into sub-samples at very fine intervals, some as short as 2 cm in length, to characterize sediment depositional chronology.

II. Equipment and Supplies

The following is a comprehensive list of sampling equipment. Not all equipment and supplies listed below will be needed for all core processing procedures.

1. Sediment Cores
2. Vertical Core Stand and Clamps
3. Plastic Basin and Plastic Sheeting
4. Core Log Sheets
5. Disposable Gloves
6. Reciprocating Saw/Sander and/or Aluminum Tubing Cutter
7. Electric Drill
8. Electric Scissors, Router, and/or Aluminum Shears
9. Tyvek Suits
10. Utility Knife
11. Safety Glasses and/or Face Shield
12. Aluminum Pans and Foil
13. Decontaminated Spoons, Spatulas, open-barrel syringes, and/or “Scoopulas”
14. Scales for Weighing Cores and Segments
15. Scales for Weighing Small Sample Volumes
16. Engineering Tape Measure
17. Sample Jars
18. Sample Labels
19. Wire/Titanium Knife
20. Stainless Steel Mixing Spoons
21. Extrusion Tools

III. Guidelines

Cores should be held overnight to allow the sediment to settle in the core tube prior to sediment processing. Cores will be kept on ice until they are processed. The field sampling team will perform the following activities associated with each core: photo-documentation, visual description, sample processing and homogenization, sample jarring, chain-of-custody and shipping documentation. Sediment samples will be analyzed for radiological dating purposes, and to determine the representative chemical and geotechnical characterization of the sediments in the study area.

1. Core Sampling: Two primary methods are available for removing sediment from cores for sampling and analysis, depending on the data needs. Please refer to Method 1 when sampling for biological and physical properties analysis. Refer to Method 2 when sampling for chemical and radionuclide dating analyses. Sampling for engineering parameters is described later in this SOP.

- Method 1: Once the core liner has been split open (using a router and cutting jig, circular saw or utility knife), use tools made from non-contaminating materials (glass, stainless steel, Teflon) to sample uniform amounts of sediment from the core. Avoid removing sediment that is in contact with the core liner, thereby reducing possible cross-contamination. Place the sediment in a pre-cleaned stainless steel bowl and mix thoroughly until a homogenous mixture is prepared (color and texture).

- Method 2 (For Chemistry Samples): The core is managed vertically at all times and samples are collected continually as the core is segmented from top to bottom. For chemistry samples, it is imperative that the sidewall smear is kept from the sample. Sediment samples will be obtained from each segment using one of the methods described below (see Core Segmentation). NOTE: For very short core segments, where the amount of available sediment sample is limited, all the sediment remaining in the core segment, after the chemistry samples have been removed, may be used for the radionuclide dating analysis. After recording physical parameters, place the sediment removed for chemistry analysis from the segment in a new, disposable food-grade aluminum pan and mix thoroughly until a homogenous mixture is prepared (color and texture). **Method 2 will be the preferential method for all High Resolution Coring Program efforts.** After the jars for chemistry analysis have been filled, the remaining core segment materials for radiological dating analysis may be placed in the same pan for mixing prior to putting in its sample jar. See core segmenting section below for details on segmenting cores, avoiding sidewall smear and handling short core segments with

small sample volumes. The methods for obtaining the sediments from the core segments is discussed below (see Core Segmentation).

2. Core Storage**:** Proper core storage is a vital part of the process. Sediment cores will be kept on ice from the time they are collected on the boat until they are segmented. Sediment cores will be placed in iced core storage holders while aboard the boat and transported to the field facility in these holders. The core sections that stick out of the top of the holder shall be wrapped with a heat reflective blanket. Sediment cores must be kept at the appropriate temperature (frozen for cores and samples to be archived, otherwise 4ºC) and in the appropriate orientation (vertical) until they are cut open and segmented for sub-sample analysis. It may be necessary to initially cut cores into two or more segments so that they will fit into a vehicle for transportation to the core processing facility. Archive cores will be cut into maximum 5' lengths, since the freezer has a headroom clearance of 6 feet. This can be accomplished using a reciprocating saw (Lexan cores) or tubing cutter (Aluminum cores) with a decontaminated blade. All exposed ends of the cores will be recapped following cutting, and the core segments will be labeled with the core designation, location, depth intervals, and an arrow to denote the proper orientation.

3. Initial Physical Measurements: After the core has been allowed to settle overnight, remove the upper cap and make a small mark on the core at the sediment water interface. Measure the length of the sediment in this core tube and add it to the length of the remaining core sections. (Inspect all core sections for voids since this will also impact recovery and may make cause the core to be rejected.) This is the length of recovered material in the core tube. Compare this length against the initial cored depth and compute the percent recovery. The required percent recovery for high resolution cores is 85%. If the percent recovery is less than 85%, then, the potential need to discard the core is to be discussed with the Processing Facility Manager. With a small diameter drill bit, drill through the core liner at a point just above the sediment/water interface and drain the excess water from the core into a container for disposal. Weigh the entire core on an engineering scale and record the total weight, in grams.

4. Bulk Density Calculation: The sediment bulk density for each core will be estimated by weighing each core after removing the overlying water. The calculation for bulk density uses the following formula:

$$\rho_{bulk} = \frac{W_{sediment}}{A_{tube} * L_{sediment}} = \frac{W_{sediment\&tube} - W_{tube}}{A_{tube} * L_{sediment}}$$

where:

ρ_{bulk}	=	wet bulk density in g/cm^3
$W_{sediment}$	=	weight of sediment in the tube
$W_{sediment\&tube}$	=	weight of sediment and the tube
W_{tube}	=	weight of the empty coring tube
	=	length of tube * weight of tube per unit length
A_{tube}	=	inner cross sectional area of the coring tube
$L_{sediment}$	=	length or thickness of sediment in the tube (Note that this is probably not the length of the coring tube itself)

5. Setup: (Method 1) Prior to splitting the cores, secure the cutting jig to a table using "C"-clamps. (Method 2) Cores that must be processed vertically will be held in specially-constructed core processing stands.

6. Core Segmentation can vary depending on the analysis type. The first method is for cores to be analyzed for biological and physical parameters. The second method is for cores that have chemical and/or radionuclide analysis requirements.

- Method 1: Cut open the capped end of the core using a utility knife. Cut the Lexan tube containing the core longitudinally with electric scissors, aluminum shears, or a router. Rotate the core 180° and repeat cutting procedure so it can be split into two equal parts. Avoid contaminating the sample whenever possible. Split the core into two halves using a wire tool or titanium knife and open the core so that sediment from both halves is visible. The core is now ready to be sampled. Please refer to SOP-12: Core Processing - Low Resolution Cores, for sediment characterization techniques.

- Method 2 (For Chemistry Samples): Cores that are analyzed for chemical contaminants and radionuclide dating are to be handled and processed vertically at all times, rather than horizontally. Cores will be segmented into 44 intervals, irrespective of the length of the core. An additional step will be

performed solely for the surficial sediment layer (0 to 2 cm) to permit the measurement of Be-7, described later. Segmenting will be done as follows:

A. Locate the black to brown sediment color transitions;
B. Measure and segment the black sediment portion into 36 equal length segments;
C. Further divide the top four segments equally into eight segments for a total of 40 black segments (32 long and 8 short segments);
D. Divide the uppermost portion of the brown sediment into 4 segments, with each segment twice the thickness of long segments used in the black sediments.

As an example, for a core of approximately 190 cm in length with the black-brown sediment transition at 144 cm, this procedure would yield the following:

- 8 segments, 2 cm thick each, representing black sediments from 0 to 16 cm below the sediment-water interface.
- 32 segments, 4 cm thick each, representing black sediments from 16 to 144 cm below the sediment-water interface, ending at the black-brown sediment horizon.
- 4 segments, 8 cm thick each, representing brown sediments from 144 to 176 cm below the sediment-water interface.

Material below 176 cm may be archived or discarded, depending on the judgment of the field crew.

Due to sample volume requirements, however, a 2 centimeter minimum core segment length has been established for this project. Therefore, for very short core retrievals, such as for a 60 centimeter core, a 2 centimeter core segmentation limit will produce a total of only 30 segments.

Segmentation and sampling go hand-in-hand with this process. Segmentation will be conducted using a tubing cutter for aluminum core tubes or an oscillating saw for Lexan core tubes. As each segment is cut from the top of the core tube, a large, decontaminated, flat-bladed knife or stainless steel plate will be inserted below the segment and used to lift the segment into a disposable, aluminum food-grade pan for extrusion, classification, and sample processing. Slicing away the outer edge of the core is important during extrusion to assure core streaking/smearing is not a factor contributing to cross-contamination of the samples. Report any observed voids to the

Processing Facility Manager; the presence of voids in the sediment may require the core to be discarded.

Due to the variety of segment lengths encountered, the following methods will be used to obtain representative, uncompromised samples:

For short segments: To prevent disturbance of the core sample which may occur due to the vibration caused by an oscillating saw used to cut very short core segments (as small as 2 centimeters in length), an extrusion tool (which pushes the core segment up and into a new section of Lexan tubing cut to the length of the desired segment) is used to remove the sediment from the core. To avoid collecting sediments impacted by side-wall smearing, sediments may be removal using a decontaminated stainless steel scoop, or an approximate 1-inch diameter, open-ended polycarbonate tube section, or open-ended syringe barrel, to "cookie cut" the chemistry samples from the core segment. If very little material is available, it will be used for radionuclide dating.

NOTE (for very short cores): For locations where very little sample volume is available (very short cores), two co-located cores may be collected by the field crew and identified to the core processing staff. To process these cores the following procedure will be followed:

A. Each core will be identified using a separate core number (core segments from these two cores are never to be composited)

B. Both cores will have full radiological analysis (as described in Sub-Section 7 below; however chemistry analysis will be split between the cores (meaning that, for example, one core may be used for the frozen PCB and dioxin/furans analysis, while the other core may be used for the other chemistry analysis requiring immediate analysis). This information will be recorded in the field application for all samples being sent to the laboratory.

C. For samples where only Be-7 samples will be collected from the top 0-2 centimeter layer: The sample will be extruded up and out of the core tube until 2 centimeters of the sediment core is visible: the sample will then be removed using a flat bladed knife and placed in the sample jar. If the sediment is very sloppy, the sample may either be extruded up a little at a time, while using a flat bladed knife to remove the sample until 2 centimeters has bee obtained. Or, alternatively, a decontaminated stainless steel teaspoon may be used to carefully remove the sediment sample down to 2 centimeters.

D. For longer core segments (up to one foot, where sufficient sediment is available for all analysis): Sediments may be removed from the segment (while avoiding sediments impacted by side-wall smear) by driving/pushing a smaller diameter new or decontaminated copper or polycarbonate tube through the core segment. This entire removed section, from the inside of the smaller diameter tube, may be used for all analysis. Alternatively, if the core segment maintains its shape, the core segment may be "shaken" and pushed out of its tube and the outside smear may be sliced away from the sample.

E. Special Segmenting for Berylium-7 Measurement: For longer cores where the length of recovery yields upper core segments greater than 3 cm, the following procedure will be added to the core sampling in order to obtain a Be-7 measurement on the upper 2 cm of sediment.

i. After extruding the first layer into a sampling holder while still maintaining the layer vertically, remove the portions for all chemical analysis from the entire layer using an open bore glass syringe or similar device.
ii. After all chemical samples aliquots are removed, the layer is to be split horizontally into two sub layers, each of which will be sent for radionuclide analysis. The upper layer will consist of sediments between 0 and 2 cm, and is intended for Be-7 analysis. The second layer, representing 2 to 'x' cm, where 'x' is the bottom of the core segment will be sent for radionuclide analysis. In this manner, Be-7 analysis will be limited to the top 3 cm of sediment in all cores, with 2 cm being the most common layer thickness.

7. Holding times vary depending on the analysis of the samples and impact sample shipment. Please refer to Tables 3-1 through 3-6 in the QAPP for specific holding time and storage parameters.

For this project, to optimize project funding, the following sample shipment/storage schedule will be adhered to, due to analytical method holding time restrictions and the analytical result sequencing needs:

Immediately:

A. Freeze archive cores (archive cores are the additional cores collected adjacent to the core being used for analysis)

B. The top 2 centimeters of each core will be sent for Be-7 analysis

C. The top 33 segments, of the total 44 segments, will be sent for the remaining radionuclide analysis

D. Each of the 44 segments will be frozen for later PCB and Dioxin/furans analysis

E. Each two successive segments, totaling 22 samples from each core, will be sent for all remaining chemistry analysis, and grain size

Once analytical results have been assessed:

A. If required, send the remaining 11 segments for radionuclide analysis (excluding Be-7)

B. Send up to 22 segments for PCB and Dioxin/furans analysis, combined in paired or multiple sediment segments as directed (this will consist of placing the jars in Ziploc bags, for the lab to combine-since they will be frozen)

8. Decontamination: Decontaminate all used tools, bowls, and mixing implements in accordance with SOP 6: Decontamination of Soil Sampling Equipment.

9. Sample Containers: The SOP "Sample Containers, Preservation, and Handling" and Tables 3-1 through 3-6 in the QAPP provide detailed information.

10. Quality Control: To ensure quality control in this process, appropriate decontamination procedures must be followed and caution must be taken to ensure that the samples are not cross-contaminated. With varying requirements for all analysis discussed in this SOP, it is critical to ensure that pertinent requirements are met for each core processing effort. Decontamination solvents may be submitted for residue analysis to ensure cleanliness, if directed by the SQO. Refer to the QAPP for the required number of field duplicates, MS/MSD, etc., for each analytical parameter.

IV. References

United States Environmental Protection Agency. Office of Water. 1995. "QA/QC Guidance for Sampling and Analysis of Sediments, Water, and Tissues for Dredged Material Evaluations." Report Number EPA 823-B-95-001.

McNeil, J; Taylor, C; Lick, W. "Measurements of Erosion of Undisturbed Bottom Sediments with Depth." J. Hydr. Engrg., Vol. 122, Issue 6, pp. 316-324 (June 1996).

Title: Core Processing – Low Resolution

I. Introduction

This standard operating procedure (SOP) describes the process for handling, characterizing, segmenting, and sampling low resolution sediment cores for chemical, radionuclide, and geotechnical analyses. Proper handling of the cores (*e.g.*, keeping cores in a vertical orientation) is critical to obtain adequate quality sediment data. This processing procedure applies to sediment cores collected using a variety of sampling techniques, including vibracoring, piston coring, or gravity cores. Low resolution cores are those cores segmented into subsamples generally at 6-inch to 2-foot intervals to characterize the spatial extent of contamination and sediment physical properties. For this project, a second type of low resolution core (a short finely segmented core) will be collected adjacent to every 3rd standard low resolution core to. Processing this core is also described below.

II. Definitions

Definitions are referenced from the ASTM D2488-00: Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Please refer to ASTM D2488-00 for more detailed definitions.

1. Clay: fine-grained soil with putty-like properties (plasticity) when containing water. If the soil is dry then it becomes hard, strong, and solid. Has a plasticity index equal to or greater than 4.

2. Gravel: particles of rock that are larger than 4.75mm yet smaller than 75 mm
   - Coarse: greater than 19mm smaller than 75mm
   - Fine: less than 19mm larger than 4.75 mm

3. Organic Clay: clay with organic content high enough to influence soil properties

4. Organic Silt: silt with organic content high enough to influence soil properties

5. Peat: dark brown to black decomposing vegetative matter with organic odor and spongy consistency

6. Sand: particles of rock between 75 μm-4.75mm:
   - Coarse: 2 mm-4.75 mm.

- Medium: 425 µm-2 mm.
- Fine: 75 µm-425 µm.

7. Silt: a fine-grained soil (<75 µm) with little or no plasticity. When soil is dry has little or no strength.

III. Equipment and Supplies

1. Vertical Core Stand and Clamps
2. Plastic Basin and Plastic Sheeting
3. Geotechnical Gauge- typically contains size classification, with actual sand grains from coarse to silt, roundness chart, percent composition chart, unified soil classification system (USCS), common soil colors, soil and sand compacting classifications.
4. Environmental Sample Core Log - use to record core characterization (Appendix 1)
5. Key to Core Data Logs - guide to core descriptions and symbology (Appendix 2)
6. Decontamination Solutions: Laboratory soap, 1% nitric acid, isopropyl alcohol, and hexane to clean utensils and other non-dedicated equipment
7. Decontaminated/dedicated stainless steel pans, new disposable aluminum pans, stainless steel spoons, spatulas and/or scoopulas
8. Engineering Tape Measure
9. Scales for weighing cores and segments
10. Sediment Cores
11. Disposable Gloves
12. Tyvek Suits
13. Utility Knife
14. Safety Glasses and/or Face Shield
15. Sample Jars
16. Reciprocating Saw and/or Aluminum Tubing Cutter

IV. Guidelines

1. Core Storage: Proper core storage is a vital part of the program. Sediment cores must be kept at the appropriate temperature (frozen for cores and samples to be archived, otherwise 4ºC) and in the appropriate orientation (vertical) until they are cut open and segmented for subsample analysis. It may be necessary to initially cut cores into two or more segments so that they will fit into a vehicle for transportation to the core processing facility. This can be accomplished using a reciprocating saw/sander equipped with a saw blade (Lexan cores) or tubing cutter (Aluminum cores) with a decontaminated blade. All exposed ends of the cores will be recapped following cutting, and the core segments will be labeled with the core designation, location, depth intervals, and an arrow to denote the proper orientation.

2. Holding times vary depending on the analysis of the samples. Refer to Tables 3-1 through 3-6 in the QAPP for specific holding time, storage, containers, and preservation parameters. Below are commonly used, standard holding times.

   - Cores for chemical analysis have a probable holding time of 1-2 weeks, depending on the selected analytical parameters, although samples for metals speciation may have very short holding times. These cores must be processed and submitted to the laboratory prior to the holding time being exceeded. Samples for PCB congener analysis and dioxin/furans analysis may be frozen.
   - Cores for biological testing have a holding time of 6 weeks. These cores must be processed, splits taken, and tests started prior to the holding time.
   - Cores for physical parameters such as Grain Size and certain engineering parameters should not be frozen. They should remain at 4ºC to prevent composition changes in the sediment.
   - Cores slated for Pb-210 and Cs-137 analyses have a holding time of 1 year. Holding times for Be-7 will be a maximum of 1 month. Sediment cores will not be held any longer than necessary prior to radionuclide analysis.

3. Setup: Cores must be handled and processed vertically, using specially-constructed core processing stands. All tools and mixing implements must be cleaned and decontaminated as described in SOP 6: Decontamination of Soil Sampling Equipment, and in Step 4, below. Core logging (See Step 7, below) should be performed prior to cutting the Lexan core tubes for processing.

4. Initial Physical Measurements: Remove the upper cap, and using a decontaminated probe, confirm the length of the sediment recovered in the core tube and check against the required percent recovery for low resolution cores of 80%. If possible, it is preferred that core measurements be taken from the outside of the Lexan core tube. If the percent recovery is less than 80%, the potential need to discard the core is to be discussed with the Processing Facility Manager. Drill through the core liner at a point just above the sediment/water interface and drain the excess water from the core. Weigh the entire core on an engineering scale and record the weight.

5. Bulk Density Calculation. The field sampling team will perform the following activities associated with each core: photo documentation, visual description, sample processing and homogenization, sample jarring, chain-of-custody and shipping documentation. Sediment samples will be analyzed to determine the representative chemical and geotechnical characterization of the sediments in the work area. The sediment bulk density for each core will be estimated by weighing each core after removing the overlying water. The calculation for bulk density uses the following formula:

$$\rho_{bulk} = \frac{W_{sediment}}{A_{tube} * L_{sediment}} = \frac{W_{sediment\&tube} - W_{tube}}{A_{tube} * L_{sediment}}$$

where:

ρ_{bulk}	=	wet bulk density in g/cm^3
$W_{sediment}$	=	weight of sediment in the tube
$W_{sediment\&tube}$	=	weight of sediment and the tube
W_{tube}	=	weight of the empty coring tube
	=	length of tube * weight of tube per unit length
A_{tube}	=	inner cross sectional area of the coring tube
$L_{sediment}$	=	length or thickness of sediment in the tube (Note that this is probably not the length of the coring tube itself)

6. Core Segmentation: cores will be segmented as follows:

   Cores are to be processed vertically. Typically, the low resolution cores will be segmented at predetermined intervals (generally 2 foot-intervals). Adjacent to every 3rd core location a short core will be installed. The field crew will identify this short core for short core segmenting and analysis. This short core will be finely segmented (0-2 cm, 2-5 cm, 5-10 cm, and 10-20 cm). Analysis of these 4

segments will consist of Methyl-mercury, arsenic speciation, hexavalent chromium; the uppermost layer will also include Be-7 analysis. This core will have its own core number.

A. To process the short low resolution core: To prevent disturbance of the core sample which may occur due to the vibration caused by an oscillating saw used to cut very short core segments (as small as 2 centimeters in length), an extrusion tool (which pushes the core segment up and into a new section of Lexan tubing cut to the length of the desired segment) is used to remove the sediment from the core. To avoid collecting sediments impacted by side-wall smearing, sediments may be removal using a decontaminated stainless steel scoop, or an approximate 1-inch diameter, open-ended polycarbonate tube section, or open-ended syringe barrel, to "cookie cut" the chemistry samples from the core segment. If very little material is available, the remaining sample will be used for radionuclide dating.

B. To process the long low resolution core: Segmentation and sampling go hand and hand with this process. Segmentation will be conducted using a tubing cutter for aluminum core tubes or a reciprocating saw for Lexan core tubes. As each segment is cut from the top of the core tube, a large, decontaminated, flat-bladed knife or stainless steel plate will be inserted below the segment and used to lift the segment into a decontaminated stainless steel bowl, or disposable aluminum pan, for sample removal, classification, and sample processing. Since these are longer segments with varying sample consistency, a variety of methods are proposed for sample removal. No matter which method is used it is important to avoid the outer smeared portion of the sample, adjacent to the core barrel wall. An extrusion device can then be used to push the core out of the core liner segment and into a decontaminated stainless steel bowl for classification and sample processing. Slicing away the outer edge of the core is important during extrusion to assure core streaking/smearing is not a factor contributing to cross-contamination of the samples. Avoiding the outer edge smear may also be accomplished by pushing/driving a smaller diameter tube (i.e., copper or Lexan) through the segment to remove the sediment sample from the core. If this method is used the entire inner portion of the smaller diameter tube can be used as sample. Prior to removing the sediment from the core, or if possible during sample removal, report any observed voids greater in size than 1 inch of void per linear foot of core to the Processing Facility Manager; the presence of an inordinate amount of void space in the sediment may require the core to be discarded.

NOTE for the long low resolution cores: From the uppermost 2' core segment a portion of the top 2-3 centimeters of the core needs to be obtained for Be-7 analysis. Therefore, to maintain the integrity of the remaining sediment a smaller diameter tube shall be driven through the 2' segment. While in place, the upper 2-3 centimeters of sediment shall be removed for Be-7 analysis. The smaller diameter tube shall then be removed for mixing in an aluminum pan and distribution among the needed sample jars.

An Alternate method to accomplish the collection of Be-7 from the upper 2-3 centimeters of sediment is as follows if the smaller diameter copper or Lexan tube cannot be properly advanced through the sample (described above), or if the sample retains its shape sufficiently: For this method, the sample will be processed horizontally. Two cuts will be made along the length of the Lexan or aluminum tube. Decontaminated flat-bladed knifes or stainless steel plates will be inserted along the length of the cut so that the core may be opened with sediment remaining in both halves (DO NOT SLIDE THESE TOOLS ALONG THE LENGTH OF THE CORE SEGMENT). From one half, the upper 2-3 centimeters of sample will be removed for Be-7 analysis and placed in a sample container. From the entire length of the remaining half, decontaminated tools will be used to remove sample from the core while avoiding the side-wall smear. The removed sample will be placed in a disposable aluminum pan, homogenized and placed in the required sample containers. Sample will be shipped to the laboratory or frozen as detailed in the FSP. NOTE: IF the upper 2-3 centimeters will not retain its shape while the core is placed horizontally then decontaminated flat-bladed tools will be inserted into the very top of the core so that the sediment will remain in one-half of the core while the Be-7 sample is being removed. The core will then be processed as described above.

7. Core Logging**:** To describe cores an Environmental Sample Core Log (Appendix 1), a Geotechnical Gauge, and the Key to Core Data Logs (Appendix 2) are required. Core logging should be performed prior to segmenting the core.

   Measure the total length of the core and record it on the Environmental Sample Core Log. Describe the core(s) in the diagram provided on the Environmental Sample Core Log. For each horizon note the color, size (segment length), texture, lithology, and odor. Also note other distinguishing characteristics such as shell hash, detritus, or presence of an organic sheen. Use Appendix 2 as a reference for additional data collection requirements. Note not all categories apply to all samples. These are a guide to the information that can be provided by a core description. Specific descriptions of each category are listed further along in this document. If a photographic record is to be obtained, the core ID should be

present in every frame as well as an RGB color indicator and a measuring tape for size reference.

A. Group Symbols: Sediments can be identified by assigning a group symbol. Flow charts representing these group symbols can be seen in Appendix 4 (fine-grained soils) and Appendix 5 (coarse-grained soils).

B. Lithology**:** The description or physical characterization of the sediment such as the approximate percent of clay, silt, or sand.

C. Dilatancy: the structural change of the soil from stress and pressure over time. This can be tested by shaking and squeezing a small round ball of the sample. The ASTM criteria are listed below and details on how to test the sample are listed in the ASTM D2488 report.

- None: No visible change in the specimen.
- Slow: Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
- Rapid: Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

D. Type: a more descriptive means of describing the soil characters such as sediment size and composition.

E. Color: a very important aspect of the core description and soil identification. Any changes in color should be noted on the sample log along with the location of the color boundary. Use a Munsell Soil Color Chart (can be on Geotechnical Gauge) to acquire uniform descriptions.

F. Consistency: using the symbols on the Key describe the consistency as hard, firm, soft or very soft. Note this is not applicable to soils with large amounts of gravel. The ASTM criteria are as follows:

- Very soft: Thumb will penetrate soil more than 1 in.
- Soft: Thumb will penetrate soil about 1 in.
- Firm: Thumb will indent soil about ¼ in.
- Hard: Thumb will not indent soil but readily indented with thumbnail.
- Very Hard: Thumbnail will not indent soil.

G. Cementation: used on intact coarse-grained sediments. The three options are weak, moderate and strong. The ASTM criteria are as follows:

- Weak: crumbles or breaks with handling or little finger pressure.
- Moderate: Crumbles or breaks with considerable finger pressure.
- Strong: will not crumble or break with finger pressure.

H. Structure: physical layout of the core. Below are descriptions of the ASTM criteria noted on the "Key to Core Data Logs" (Appendix 2).

- Homogeneous: Same color and appearance throughout.
- Stratified: Alternating layers of varying material or color with layers at least 6 mm thick; note thickness.
- Laminated: Alternating layers of varying material or color with the layers less than 6 mm thick; note thickness.

I. Maximum particle size: note the largest particle size seen in the sample. The "Key to Core Data Logs" has the appropriate abbreviations and descriptions. More details can be found in the ASTM D 2488 paper.

J. Odor: Note any organic or non-organic odors that may be released when opening the core. Many soils have a strong, distinctive odor of decaying vegetation. It is important to also note any chemical or petroleum odors.

K. Samples: Used to identify sample ID. Also, this column can be used to denote where the core may have been split to acquire numerous samples.

L. Toughness: the amount of pressure need to roll a sample of the soil into a $1/8^{th}$ inch diameter (plastic limit) thread and the strength of the thread. The ASTM criteria are listed below.

- Low: Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft.
- Medium: Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness.
- High: Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness.

M. Plasticity: using the information gathered in the toughness test use the ASTM criteria to rate the plasticity of the sample.

- Non-plastic: A 1/8 in. thread cannot be rolled at any water content.
- Low: The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
- Medium: The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be re-rolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.

Sample Containers: Tables 3-1 through 3-6 in the QAPP provide detailed information on sample containers, preservation, and handling. Below are some standard requirements for sediment samples.

- Samples to be analyzed for physical parameters such as grain size and TOC should be stored in pre-cleaned glass jars.
- Samples to be analyzed for chemical parameters should be stored in laboratory certified pre-cleaned glass jars.
- Samples to be analyzed for biological parameters should be in stored in pre-cleaned plastic buckets. Note typically large quantities of sediment are needed.
- Samples to be analyzed for metals parameters should be stored in pre-cleaned, tared polystyrene containers or wide mouth, certified precleaned glass with Teflon lined lid.
- Samples to be analyzed for radionuclides should be stored in pre-cleaned, tared polystyrene containers.

8. **Decontamination:** Decontaminate all tools, bowls, and mixing implements in accordance with the following procedures prior to mobilization into the field**.**

- Rinse each item with tap water to remove mud or dirt.
- Scrub the item with a brush and soapy (*i.e.*, Alconox) water.
- Rinse the item with tap water again to remove any residual soap.
- Rinse the item with deionized water.
- Rinse the item with 1% nitric acid.
- Rinse the item with deionized water.
- Rinse the item with isopropyl alcohol.
- Rinse the item with deionized water.

- Rinse the item with hexane.
- Rinse the item with analyte-free water.
- Wrap the item in aluminum foil to protect it until it is to be used, or in the event the item is too large, cover with clean plastic sheeting prior to usage.

An adequate supply of sample handling equipment *(e.g.*, bowls, trowels) will be brought into the field during each field sampling event to avoid the need for field decontamination using solvents, as referenced above. Larger sampling equipment (*e.g.*, corers, grab samplers, vibracore), will be field decontaminated by scrubbing off all sediment visible residue and then rinsing the equipment in ambient water.

9. **Quality Control**. Decontamination solvents may be submitted for residue analysis to ensure cleanliness, if directed by the SQO. Refer to the QAPP for the required number of field duplicates, MS/MSD, etc. for each analytical parameter.

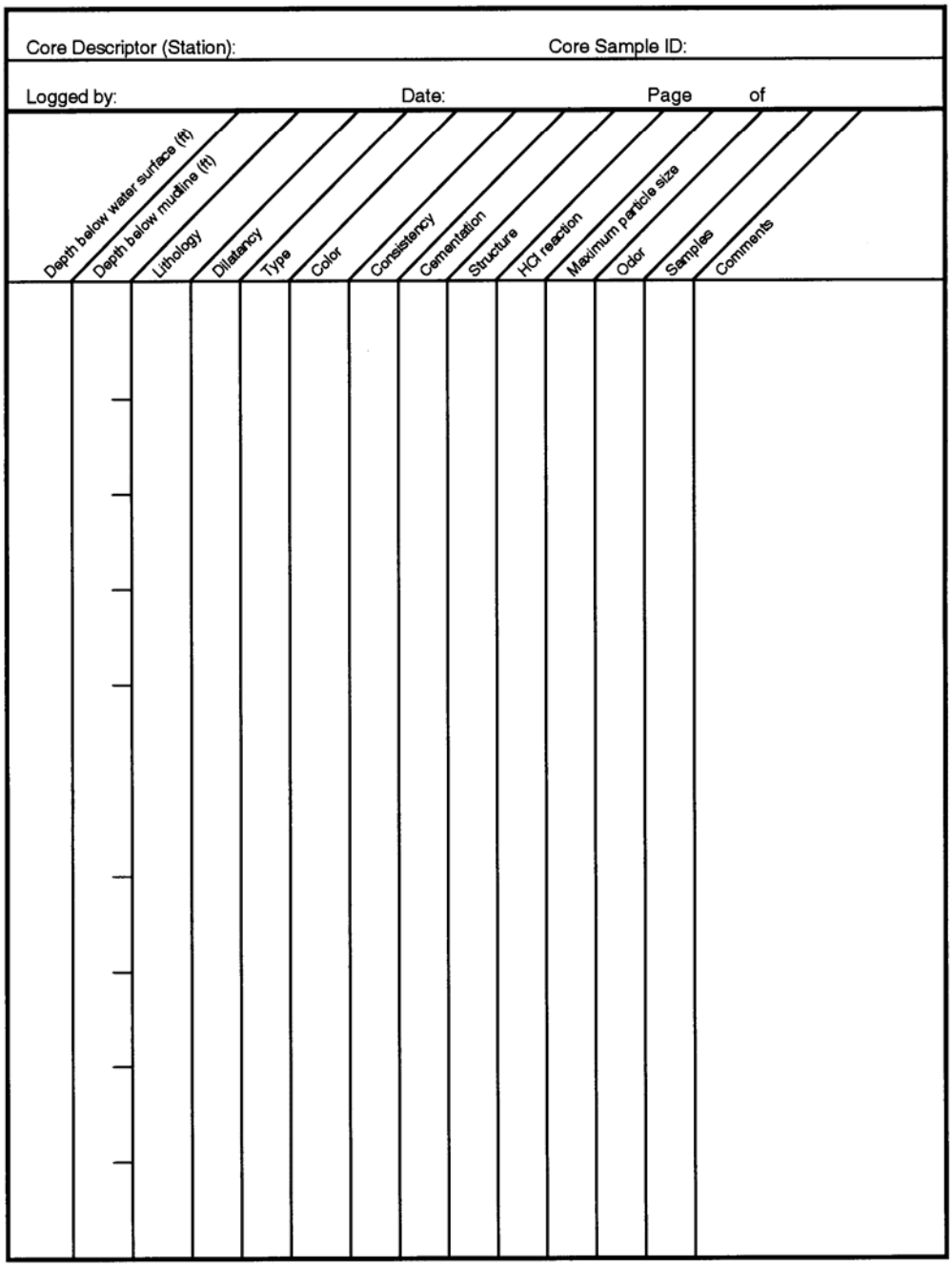
V. Reference

ASTM International Designation: D 2488-00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Edition 2000

VI. Appendices

1. Blank Environmental Sample Core Log Form
2. Key to Core Data Logs
3. Example of Completed Environmental Sample Core Log Form
4. Group Symbol Flow Chart for Fine-Grained Soils
5. Group Symbol Flow Chart for Course-Grained Soils

Appendix 1
Environmental Sample Core Log Form

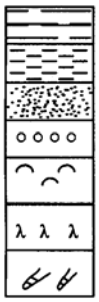


Reviewed by_____ Date _____

Appendix 2
Key to Core Data Logs

KEY TO CORE DATA LOGS

LITHOLOGY



Clay
Silt
Sand
Pebbles
Shells
Roots/organic matter
Worms/worm tubes

TYPE

GW	Well-graded gravels, gravel-sand mixtures
GP	Poorly-graded gravels, gravel-sand mixtures
GM	Silty gravels, gravel-sand-silt mixtures
GC	Clayey gravels, gravel-sand-clay mixtures
SW	Well-graded sands, gravelly sands
SP	Poorly graded sands, gravelly sands
SM	Silty sands, sand-silt mixtures
SC	Clayey sands, sand-clay mixtures
ML	Silts and very fine sands, silty or clayey fine sands, or clayey silts, with slight plasticity
CL	Clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
MH	Silts or fine sandy silts with moderate plasticity
CH	Clays of high plasticity, fat clays

COLOR

Selected from Munsell Soil Color Chart

CLAY/SILT CHARACTERISTICS

DILATANCY
N = None
S = Slow
R = Rapid

TOUGHNESS
L = Low
M = Medium
H = High

CONSISTENCY
Penetration of thumb:
<0.25 cm = hard (H)
0.25 – 2.0 cm = firm (F)
2.0 – 4.0 cm = soft (S)
>4.0 cm = very soft (VS)

CEMENTATION
N = Not cemented
W = Weakly cemented
M = Moderately cemented
S = Strongly cemented

STRUCTURE
H = Homogeneous
S = Stratified
L = Laminated
M = Mottled

HCl REACTION
N= None
W = Weak
S = Strong

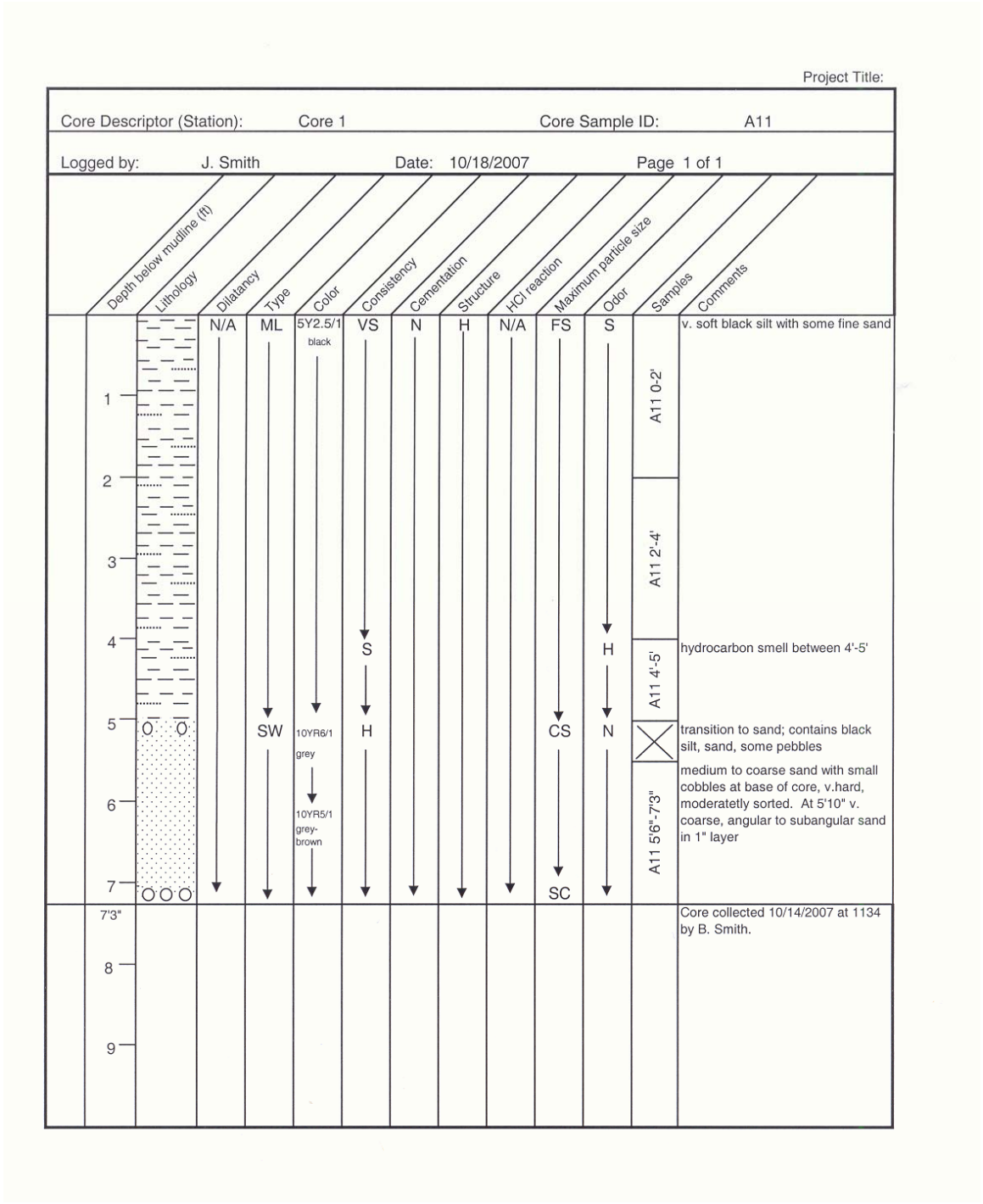
MAXIMUM PARTICLE SIZE
SC = Small Cobble
CP = Coarse Pebble
MP = Medium Pebble
SP = Small Pebble
CS = Coarse Sand
MS = Medium Sand
FS = Fine Sand
VFS = Very Fine Sand
Z = Silt

SA = Sub-angular
VA = Very angular

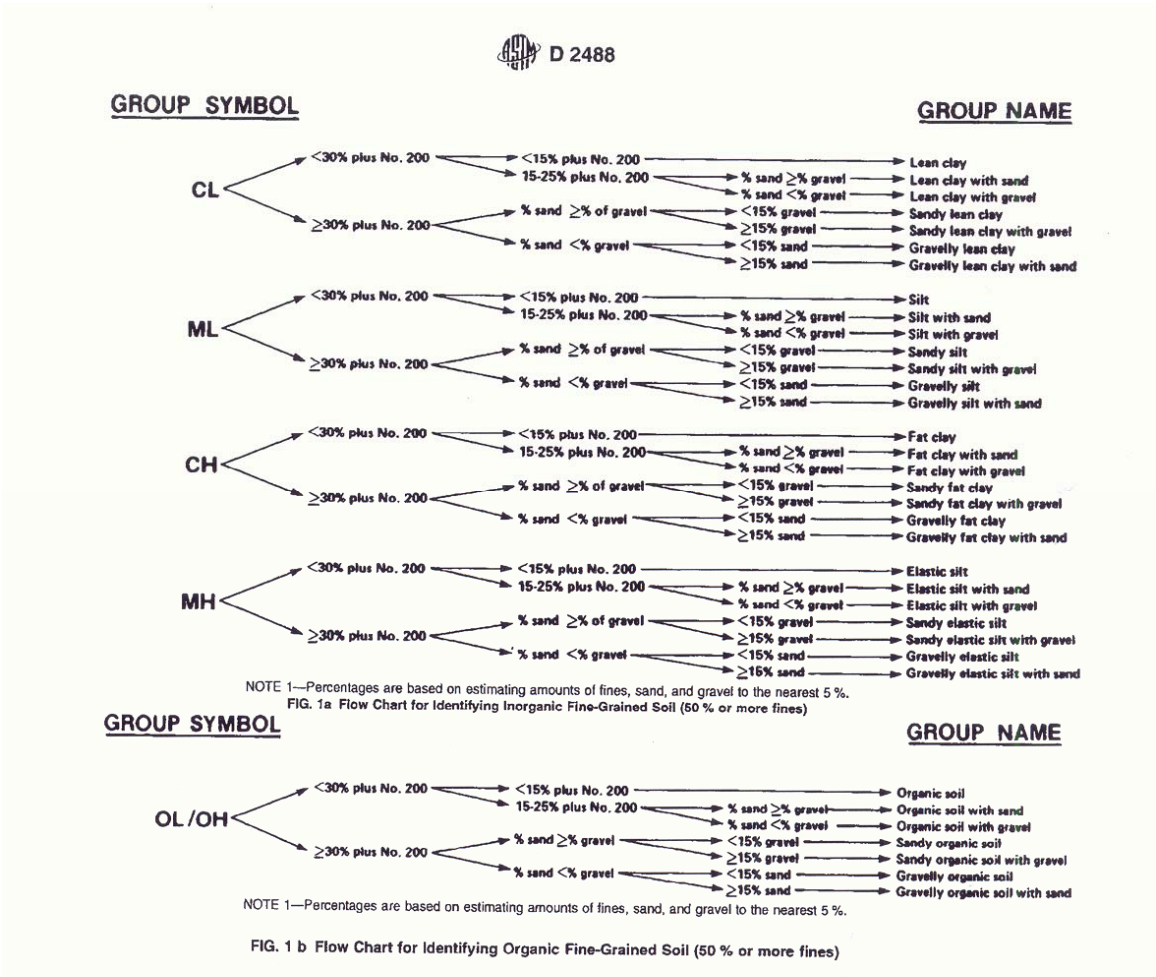
ODOR
N = None
S = Sulfide; HS = Hydrogen sulfide
P = Petroleum

PLASTICITY
N = None
L = Low
M = Medium
H = High

Appendix 3
Completed Environmental Sample Core Log Form



Appendix 4
Group Symbols
Flow Chart for Fine-Grained Soils



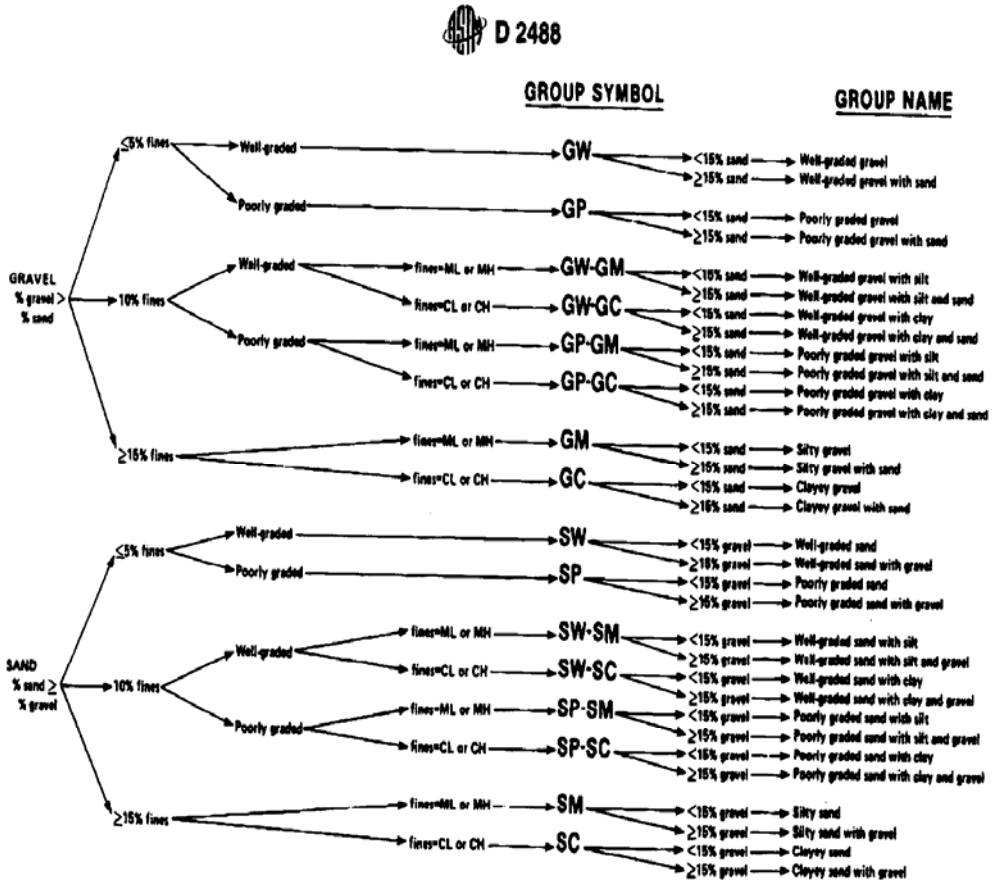
NOTE 1—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 1a Flow Chart for Identifying Inorganic Fine-Grained Soil (50 % or more fines)

NOTE 1—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 1 b Flow Chart for Identifying Organic Fine-Grained Soil (50 % or more fines)

Appendix 5
Group Symbols
Flow Chart for Course-Grained Soils



NOTE 1—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 2 Flow Chart for Identifying Coarse-Grained Soils (less than 50 % fines)

Title: Sediment Collection Using Hand Coring Devices (including push cores, piston cores, etc.)

I. Introduction

This procedure describes the equipment and methods to be used to collect sediment cores for the Lower Passaic River Restoration Project. This procedure specifically addresses collection of sediment cores via hand operated coring devices (*e.g.*, push coring and piston coring). Other coring methods (collection of sediment cores via vibracoring or split spoon and rotary drilling rig) are addressed in SOP-9: Vibracoring – Collecting High and Low Resolution Cores, and SOP-10: Split Spoon Sample Collection.

II. Equipment and Supplies

The following equipment will be needed to collect sediment cores:

1. Push core and ancillary equipment required for use.
2. Piston core and ancillary equipment required for use.
3. Polycarbonate or Cellulose Acetate Butyrate (CAB) Tube of appropriate diameter and wall thickness for use as a liner with the coring apparatus.
4. Hand operated winch (*e.g.*, 'come-along') and tripod or tetra pod (*e.g.*, folding ladder) or other lifting frame if needed.
5. Bentonite-cement grout as required by the workplan.
6. Personnel protective equipment (PPE) - including hard hat, steel toes boots, safety glasses, ear plugs, and clean disposable gloves (nitrile preferred).
7. Measuring tapes, scales, field books, pens, pencils, and pavement markers, digital camera, field application equipment, and GPS.
8. Tape – electrical, duct, and clear packing tape.

III. Guidelines

1. All data from sediment core collection will be recorded in the laptop-based field application. Upon completion of sampling at one location, all data from the core collection will be entered into the field application. The field application will prompt the user for the required information and also automatically upload daily weather and tidal conditions from the NOAA website. Blank field log sheets to record information manually will be provided in case difficulties with data entry into the field computer are encountered. Manually recorded data will be transcribed into the field application at the end of each day.

2. Hand or piston cores are used when the water level is too shallow for the vibracoring vessel to navigate (*i.e.*, less than approximately 2 feet of water), or if a land site location is not accessible by large equipment (*e.g.*, truck or tractor rig). In shallow water, cores will be collected from jon boats, zodiacs, or other appropriate vessel. If on land (*e.g.*, intertidal or other location inaccessible by heavy equipment) appropriate PPE will be used for the hand collected sample. A hand held GPS/antenna will be used to determine the coordinates of the actual sampling location.

3. Using the hand held GPS system, mark a location within 5 feet of the preprogrammed target coordinates for each sample location. Record in the field application the actual location from which the core was collected and the target location.

4. Use a calibrated steel rod to probe the sediment surface 3 to 5 ft away from the target location to determine the sediment thickness and type in accordance with the SOP-8: Sediment Probing.

    - If the estimated sediment thickness at the probing area is greater than 6 inches, record probing information in the field application and attempt to collect a core using the hand core device (steps 5-9).
    - If the estimated sediment thickness at the probing area is less than 6 inches, additional probing of the sediment surface will be conducted within 3 feet of the target location for deeper sediments. If thicker sediments are found, relocate to the new location and attempt to collect a core (steps 5-9).
    - If sediment depth appears to be systematically less than 6 inches, make one attempt at collection with the hand core device. If 80% recovery is not achieved after one attempt, collect a sample with a ponar dredge (refer to SOP-9: Vibracoring (which includes the use of a Ponar Dredge).

5. Once the targeted area is deemed suitable for core collection, mount a clean coring tube onto the coring device.

6. Prior to pushing in the core tube, mark the target penetration depth on the outside of the tube. Lower the coring apparatus with the core tube attached vertically through the water column (cutting edge first) until the sediment water interface is reached. Continue to push or hammer by hand the hand or piston core device until the target depth is reached. If using a piston core, activate the release mechanism.

7. Measure and record the depth of core tube penetration into the sediments in the field database.

8. Pull the apparatus upward out of the sediment/soils (using a hand operated winch from a tripod or other lifting frame as needed), and raise it just above the sediment water interface maintaining the core in a vertical position.

9. As soon as possible (while the core is still under water if possible) place a cap over the bottom of the core to prevent the loss of material from the core tube. Secure the cap in place with electrical or duct tape when brought on board the vessel.

10. Record the penetration depth in the field application. Remove the core liner from the outer tube. Place a second cap on the top of the core tube. Secure the cap in place with electrical or duct tape. Rinse the outside of the core tube with a small amount of river water. Measure the recovered length of the sediment core and record the data in the field application.

11. Compare the length of the recovered core with the core penetration depth.

    - If the recovered length of the sediment core is more than 80% of the penetration depth, keep the core.

    - If an insufficient amount of material is recovered, put the core tube aside while additional attempts are made to meet recovery goals (see below). If a compliant core is obtained, discard the non-compliant core into a re-sealable 5-gallon pail and store for subsequent IDW disposal.

    A. An additional attempt will be made at a minimum distance of 1 foot from previously attempted locations.
    B. A maximum of three attempts to collect a core will be made for a given location ID.
    C. Rinse the core tubes with river water, or tap water and deionized water if river water is not available, between consecutive attempts.
    D. If all three attempts to collect a core are unsuccessful based on recovery alone (*i.e.*, less than 80% recovery), retain the final core for analysis and put flag in the field application that indicates that the targeted recovery was not achieved.
    E. If an acceptable core cannot be collected within 3 feet of the node location, collect a ponar dredge sediment grab sample [refer to SOP-9: Vibracoring (which includes the use of a Ponar Dredge)] and note conditions preventing core collection in the field database.

12. After a successful core recovery enter prompted information into the field application:

    A. Date
    B. Time of recovery
    C. Actual coordinates of the sample location
    D. Water depth (ft)
    E. Core tube material (*e.g.*, Lexan®)
    F. Core penetration depth (inches)
    G. Observations, including probing results

13. Draw an arrow on the core tube with permanent marker to mark the top of the core. Label the core with waterproof label or permanent marker indicating station ID, date, and time.

14. Store the core vertically in a core tube cooler on ice. Use a tarp to keep the cores in the dark until they are transported to the field processing facility.

15. At locations where core samples cannot be collected, grab samples will be collected by lowering a ponar dredge until it comes in contact with the sediment and the release mechanism trips. Follow the grab sampling procedures in [refer to SOP-9: Vibracoring (which includes the use of a Ponar Dredge)].

16. Decontaminate the equipment and sampling tools according to decontamination procedures described in SOP 6: Decontamination of Soil Sampling Equipment.

17. At the end of each day, an electronic copy (disk) of the field application that includes the information recorded for each core sample collected that day will be created as a back up of that day's project information. This information will also be transmitted to the processing laboratory coordinator via duplicate copy or it will be uploaded to a website for download by the laboratory coordinator. Additionally, a hard copy of the field application will be printed out. The hard copy will serve as a back-up to the electronic copy, as well as the chain of custody form from the field to the processing laboratory. This form will be signed by sample collection personnel and core processing personnel at the time that the core processing personnel take custody of the cores. A copy of the signed field log form will be maintained in the processing laboratory.

IV. Reference

American Society for Testing and Materials (ASTM), 2000. Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes. Designation: D 1587-00.

Place Holder for SOP 14: X-radiograph Procedures

Place Holder for SOP 15: Density Profiler

Title: Standard Operating Procedures for Infiltrex 300 Trace Organic Sampling System

(Adapted from Axys Environmental Systems Operations Manual)

Photo of Infiltrex 300 Trace Organic Sampling System

I. Introduction

This procedure describes the equipment and methods to be used to operate the Infiltrex 300 Trace Organic Sampling System (Infiltrex 300) for the collection of discrete filtered samples (organics) using an XAD-2 resin trap, and suspended solids samples produced during the filtering process. The Infiltrex 300 is a commercial version of the TOPS sampler (modeled after the INFILTREX) and is available from Axys Technologies. It can operate from any water sampling platform and removes solids and hydrophobic organic compounds (HOCs)/organometals from water samples in the field through the use of filters and XAD-2 traps. A lead-time of 2 or more weeks may be required when ordering filters and XAD-2 resin traps and filters. The Infiltrex 300 has been used for many years in multiple river systems (*e.g.*, Ohio River) similar in complexity to the Passaic River, with great success. It is a proven

system for water column sampling when field filtering large water volumes (e.g., 20L to 1000L) is necessary.

II. Equipment

The Infiltrex 300 unit has the following components within a box frame:

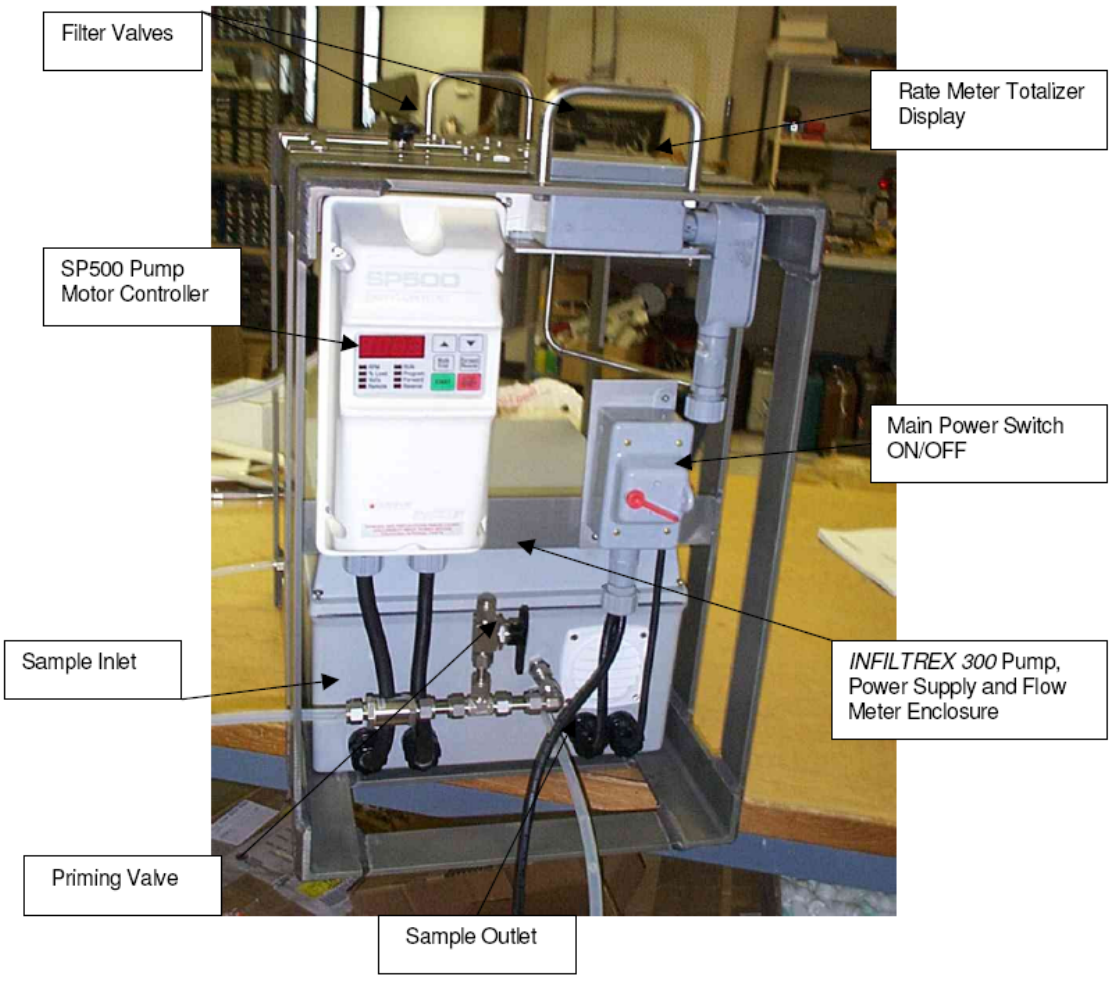
1. Enclosure housing the Infiltrex 300 positive displacement, gear type pump (220 VAC), power supply, and flow meter (pump receives with feedback control from the flow meter). Flow meter is an optically sensed turbine with redundant volumetric logs (Watchman, Totalizer / rate meter) and a magnetic level switch.
2. Reliance Electric SP 500 3-Phase Variable Frequency Pump Motor Controller.

Pump Motor Controller and Main Power ON/OFF Switch

3. Main Power ON/OFF switch.
4. Rate Meter / Totalizer Display.

Totalizer/Rate Meter

5. Sample Inlet
6. Inline Filter/Screen
7. Inlet Flow Meter
8. Priming Valve
9. Sample Outlet
10. 4" Cartridge Filter Housings
11. Amberlite XAD-2 70-gram Extraction Column.
    or,
    XAD-2 250-gram Extraction Column
    Columns are available is either Teflon or stainless steel. Column selection is based on the anticipated concentrations in the water and the water volume to be pumped. Refer to the FSP for the column selection and optimal pumping rate/total volume.
12. Non-Contaminating Fluid Transfer Tubing.
13. User's Manual



Supplies:

1. Unopened Reels of Teflon or Teflon-lined High-Density Polyethylene (HDPE) (interior diameter of 3/8-inch, outside diameter of ½-inch). Needed to collected water samples from a pre-determined location within the river.

2. Inlet Screen to filter out large particles that may clog the system.

3. 5 to 10L Graduated Cylinder: to be filled with water after it passes through Infiltrex 300 for quality control check against the Infiltrex 300's totalizer.

4. Buoy and Anchoring Mechanism: Needed to establish sample locations within river and hold HDPE tubing in place while water sample collection activities are being performed.

5. Boat/Waders: needed to get to water sample location.

6. Personnel protective equipment (PPE): None (Aside from PFDs on boats, waders, and HASP PPE such as protective gloves.)

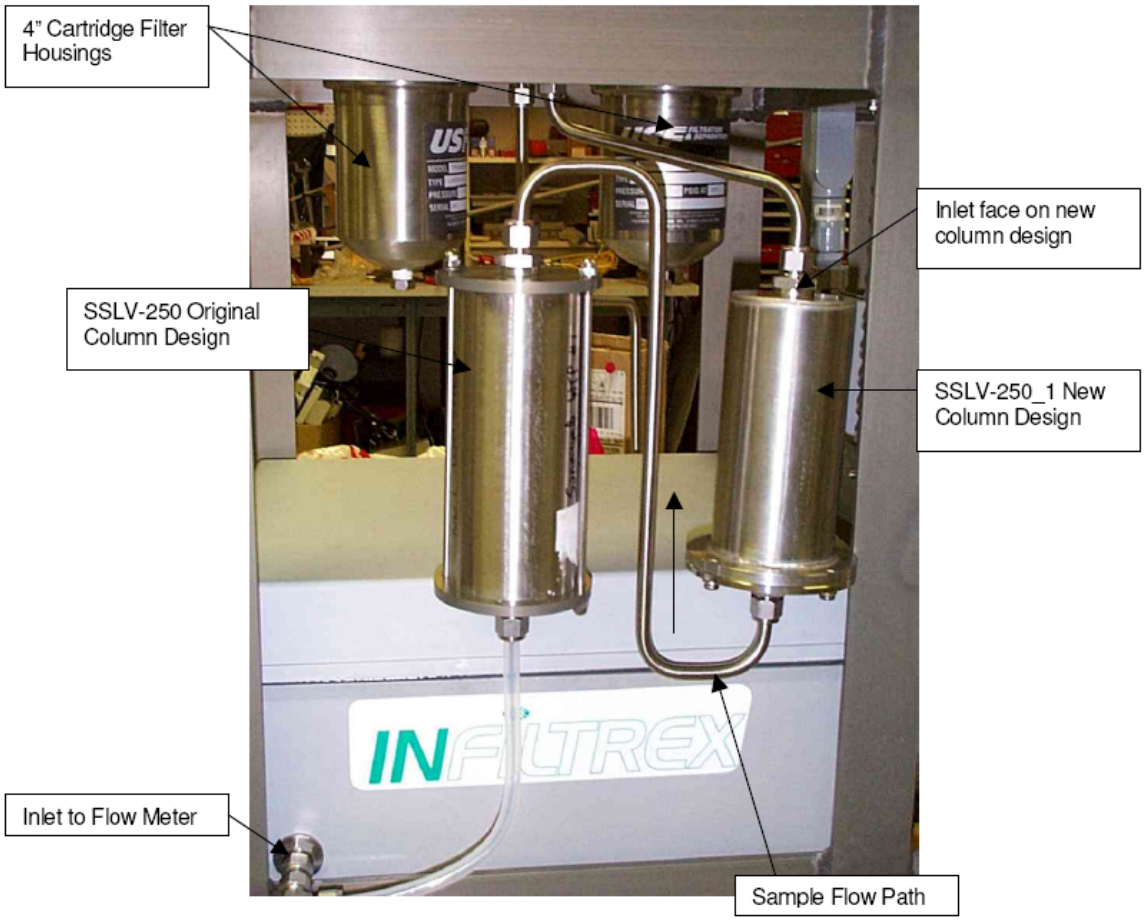
7. Electric generator or onboard 120VAC equipped with GFCI protection.

8. Miscellaneous Supplies – Garbage bags, decontamination supplies (Brushes, Liquinox, potable water, laboratory-grade deionized water) tape measure, field book, digital camera, field application equipment, deployment buoy, cooler, ice, and GPS.

III. Guidelines

Pre Sampling Procedures (XAD-2 Column – Installation/Removal):

XAD-2 Columns are shipped in clean, sealed bags separate from the Infiltrex 300 supplier. Immediately prior to sampling, remove the caps from the column fittings. These caps will be used later to seal the column, so they should be stored in a non-contaminating, sealed package. It is possible for a small amount of the alcohol or water buffer from the packaging process to be released when the end caps are removed. Always visually confirm the integrity of the retaining screen in each end before installing the columns on the instrument. Connect the fittings from the Infiltrex 300 tubing to the column fittings using the following procedures:



Connection of the XAD -2 70 Gram Teflon Column (See FSP for correct column size):

1. When ready to install, remove the caps from the ends of the column fittings. Remove only the nut from the end fitting – not the whole column end. The column end, which is also threaded, should not be removed in the field. It should only be removed to change the resin.
2. Push the tube directly into the column end fitting hole until it seats.
3. Hold it there and turn the fitting nut onto the threads until finger tight.
4. Pull back the tube lightly. It should move roughly a millimeter and stop as the grip inside the fitting nut drops into the groove on the tube.
5. Tighten the fitting nut ¾ of a turn beyond finger tight. Do not tighten further. Over tightening will damage the Teflon threads.

6. After all the tubing for the columns are connected and aligned, the tube fitting nuts should all be tightened securely, and checked.

Connection of the XAD -2 250 Gram Stainless Steel Column (See FSP for correct column size):

1. When ready to install, remove the caps from the ends of the column fittings. Remove only the nut from the end fitting – not the whole column end. The column end, which is also threaded, should not be removed in the field. It should only be removed to change the resin.
2. Push the tube directly into the column end fitting hole until it seats. There are two versions of the XAD-2 250 Gram Stainless Steel Column. The latest version of the XAD-2 250 Gram Stainless Steel Column is a welded unit that is not symmetrical and has only one end cap. The latest version of the XAD-2 250 Gram Stainless Steel Column has a flow path indicated on the end caps, showing "INLET" and "OUTLET". Be sure that the columns are not mounted upside-down otherwise, some of the solid phase resin may be lost.
3. Hold it there and turn the stainless steel Swagelok fitting nut onto the threads until finger tight.
4. Pull back the tube lightly. It should move roughly a millimeter and stop as the grip inside the fitting nut drops into the groove on the tube.
5. Tighten the fitting nut 1/2 of a turn beyond finger tight. Do not tighten further.
6. After all the tubing for the columns are connected and aligned, the tube fitting nuts should all be tightened securely, and checked.

Particle Filters – Installation:

A particulate cartridge–type filter is necessary for all actions since large volumes of water will be pumped. If any particulate matter is allowed to enter the column, it will soon coat the extraction material and either stop or greatly reduce the material's extraction efficiency. The cartridge-type filter for particulate removal prior to organic analysis (trace organic compounds) are wound glass fiber with a stainless steel core. Specifically, AXYS recommends a Heat Purified Glass Fiber Wound element (Product Number 1A4SE) made by Filterlite (301) 252-0080. These filters have a nominal 1 micron extraction capability.

1. Two cartridge filter housings are located on the top of the assembly and are opened by completely loosening the 1-inch, stainless steel nut. This will allow the lower stainless steel housing to be removed in order to access the used 4-inch cartridge or to load a new filter element.

2 When unloading filter elements, the filter bowl will contain water. Do not spill particulate-laden water if it is required for analysis. The recovered cartridge, plus residual water should be placed into a clean glass jar for analysis. A pre-cleaned wide-mouth glass jar will be used to hold the filters, standing water, and the wash-out from the filter holder. (Wash-out water is generated by using lab-certified water to rinse residual solids into the wide-mouth jar. Label the jar and enter the pertinent information into the Field Application.

In-Line Filter:

3 Prior to sample water entering the Infiltrex 300, it passes through an in-line 140-micron filter (or inlet screen). Algal growth and larger suspended solids within the Passaic River may reduce the efficiency of the sample flow rate. If the Infiltrex 300 pressure gauge is not registering pressure or is meandering at or below 5 psi, then stop the pump. At this point, switch to a back-up in-line (140 micron) filter by swapping them (takes less than 5 min). Piping entering the system can be split with an in-line control valve to divert sample water to a second in-line filter to reduce the amount of downtime. Place the used in-line filter into a laboratory-supplied glass jar and place within an iced cooler. Label the jar and enter the pertinent information into the Field Application. A decision may be made to analyze the particulates within the filter. Restart the pump and check the flow rate.

Deployment of Tubing for Sampling;

1. Prior to sample line deployment, acquire sampling locations using GPS and record location. Assess the need to set buoy in place prior to the day of the performing sampling with the Infiltrex 300 unit, if possible. This will permit rapid access to the proposed water sample location and minimize the amount of equipment carried the day of sampling. Sample locations will be co-located at SPMD deployment locations, where directed in the FSP.

   For the salt wedge water sample (brackish/saline water zone) location verify that the location is indeed within the salt wedge at the time of setting the anchoring mechanism, using a salinity meter. Salinity will not be as concentrated as the ocean, and will most likely be around 24 PPT, or less. Relocate as needed to assure that the sample will be collected in the salt wedge through the entire sample collection period as the tide recedes.

At sample locations requiring deployment in the salt wedge (2 feet above the river bottom), a weight (approximately 40 lbs) attached to a buoy will be dropped. From the weight 2' a rope section will be attached to a submerged float so that the end of Teflon (or equivalent) tubing (tubing inlet) will be positioned at 2 feet above the bottom.

For locations where a sample is to be collected 2 feet below the surface, the Teflon (or equivalent) tubing inlet will be suspended from the buoy (deployed as above). A small weight may be suspended from beneath the Teflon (or equivalent) tubing inlet, if necessary, to keep the tubing at a fixed position.

At locations where less than 5 feet of water is anticipated, anchoring mechanisms will consist of a rebar post driven into the sediment at least 3 feet, if possible. Since these locations are accessible by the public, and vandalism is possible, buoys will not be affixed to the rebar anchor. GPS readings will be taken, when possible.

In the event that GPS readings are not possible, due to trees or other overhead obstructions, measurements to nearby landmarks will be recorded. Compass direction or a description to the location will be recorded.

Devices for positioning Teflon (or equivalent) tubing shall be scrubbed in Alconox, rinsed with tap water, and wrapped in foil in preparation for Teflon (or equivalent) tubing deployment.

2. Deploying the Teflon (or equivalent) tubing: Become familiar with the following deployment procedures and prepare for the sequence that follows.

3. Keep the new Teflon (or equivalent) tubing within its shipping container/wrapping until it is transported to the river.

4. Travel to the pre-determined water sample buoy location, anchor the boat at a downstream location and **turn off the engine**. Make sure that the bow of the boat is adjacent to the proposed water sample location and that the boat engine is at the farthest possible down-wind location relative to the pre-determined water sample location. Check the GPS location and verify that the location has not moved. Different tidal cycles, or wind events, will create an artificial shift in the GPS location due to the position of the buoy. If in doubt, tug on the line to verify that the weight is securely in place. Adjust as necessary. (Shallow locations, especially in tributaries, will be waded to.)

6. After arriving at the deployment site and shutting-off the boat engine, make sure to shut-off generator or any other vapor emitting device. No fuel leaks or oily rags may be aboard the boat.

7. Teflon (or equivalent) tubing inlets will be deployed 2 feet from the surface in the channel of the Passaic River. At locations where there is 4 feet of water or less at low tide, Teflon (or equivalent) tubing inlets will be deployed at mid-depth of the anticipated low water depth. Record the water depth. At locations where saline and fresh water layers exist two sets of Teflon (or equivalent) tubing will be deployed: one 2' from the surface and one 2' from the river bottom.

8. Record all Horiba measurements using a calibrated meter.

9. For the salt wedge water sample (brackish/saline water zone) verify that the location is indeed within the salt wedge at the time of deployment and throughout the sample collection period. Salinity will not be as concentrated as the ocean, and will most likely be around 24 PPT.

10. **While wearing clean gloves**, remove the Teflon (or equivalent) tubing from its shipping container/wrapping. Note: Avoid allowing particulates to enter the tubing during installation. Particulates entering the Teflon (or equivalent) tubing could prematurely clog the Infiltrex 300's in-line filter and lessen the sample flow rate.

11. Attach a sufficient length of the Teflon (or equivalent) tubing (approximately 4-inches from the inlet opening) to the weighted lead line or buoy suspension line and submerge the tubing. Lower the tubing to the predetermined deployment depth.

12. Record GPS coordinates and time of deployment of the Teflon (or equivalent) tubing into the river.

13. Operate the Infiltrex 300 until the required volume of water has passed through the system. (See FSP for required volume.)

14. Attach sufficient length of tubing to the output portion of the Infiltrex system to allow a free range of tubing motion for filling graduated cylinders with water. During the pumping process, these cylinders are to be used as quantitative verification to check the actual pumped volume against the Infiltrex 300's totalizer volume.

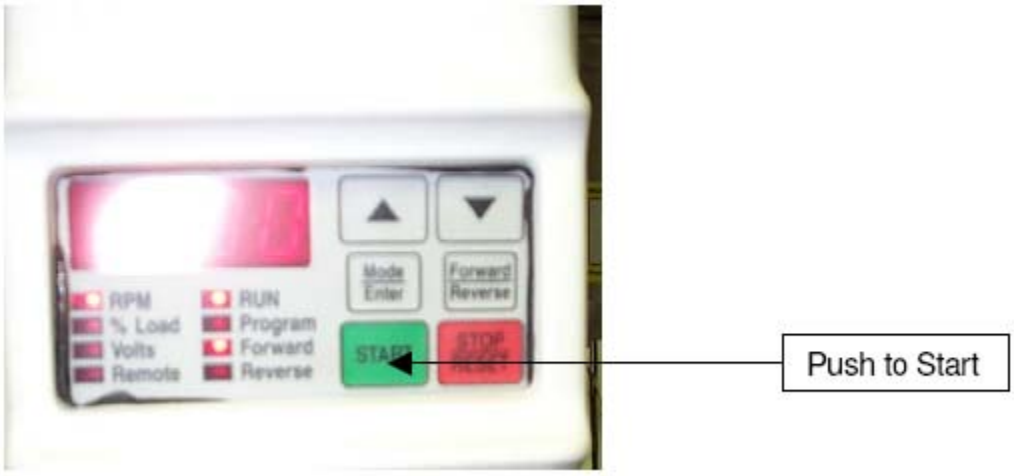
Initiation and Final Check:

Once the HDPE tubing is attached to the Infiltrex 300 inlet, the column and filter components have been assembled, and the fittings have been tightened, the operator initiates the sampling by starting the pump. The pumping sequence is started by:

1. Keeping the electrical generator exhaust at the furthest safe distance on the boat, start the generator. Be sure to have all proper GFCI protection devices in operable condition. Take note of the wind direction relative to the generator's exhaust.

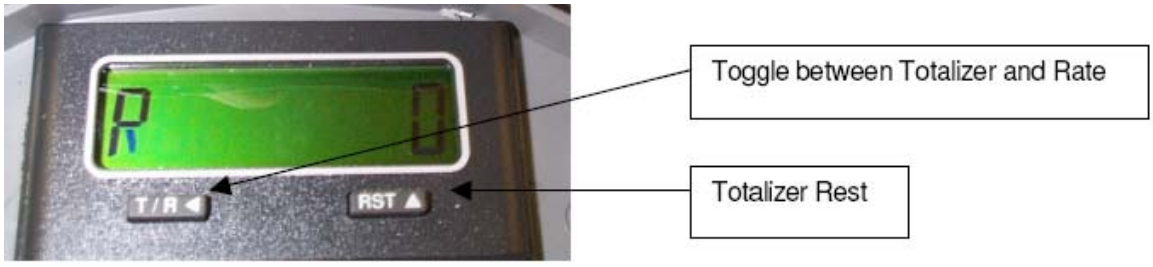
2. Turn the main power switch to "ON".

3. Press the "START" button on the SP500 control unit. Record the date and time that the Infiltrex 300 starts. Additionally, record ambient air temperature and weather conditions (*i.e.* sunny, air temperature 65 degrees Fahrenheit, wind south @ 10-15 mph).



4. The speed of the pump is controlled by pressing either the "UP" arrow to increase the Revolutions per Minute (RPM), or the "DOWN" arrow to reduce the RPM. The number displayed on the monitor is the motor RPM.
5. Three lights should be active in "Normal" sample mode "RPM", "RUN", and "FORWARD".

6. To stop a sample, press the "STOP" button on the controller and turn the power off.
7. To prime the system plumbing, a purge valve is located upstream of the inlet filter. Open the purge valve and add analyte free (de-ionized) water to fill the inlet piping and pump head prior to starting the sample.
8. Reset the totalizer meter located on top of the unit to zero at the start of a sampling event by pressing the reset switch. Once the Infilrex 300 is pumping, it is under the direct control of the operator who can manually adjust the sample stream flow rates to the desired values. A toggle switch on the totalizer display to change between "Totalizer" and Rate Meter." According to AXYS Technologies, the recommended sample flow rate for a 70-Gram column is between 100 ml/minute and 150 ml/minute. Axys technologies recommends the slower of the two above-mentioned sample flow rates for best efficiency of the 70-Gram column.



9. Stop the Infiltrex 300 pump at 20 liters (as also verified by the manually-filled graduated cylinder(s).

Column and Filter Removal:

Columns and filters will be sent to the laboratory for analysis. Adhere to the following procedure to prevent compromising the integrity of the column or filter.

1. After stopping the sampling process, turn off all switches and sources to the Infiltrex 300 unit. Remove the XAD-2 columns following the reverse of column installation process noted above.
2. Shut off generator.
3. Wearing new, clean Nitrile gloves, replace the end caps to each column. Make sure to use the original end caps removed and properly stored for each XAD-2 column. The column then can be stored up to three months prior to analysis with no special precautions.
4. Columns should not be frozen, as freezing can break down the extraction material and cause alterations in the blank levels and column performance.

5. If filters are to be analyzed, they must be handled with solvent cleaned metal tongs, wrapped in clean aluminum foil, and kept cooled until analyzed.

Field Blanks:

(Refer to the QAPP for Field Blank collection)

Field blanks can be taken for both the XAD-2 resin column and the glass fiber filter. Field blanks for the XAD-2 columns are collected by leaving both ends of a column open while the filled sample columns are being loaded into the sampler. Similarly, the two glass fiber filter blanks are collected by exposing a filter to the air while loading the sample filters into the cartridges. The field blank should receive the same analytical treatment in the laboratory as the field samples.

Retrieval after Sample Recovery:

1. Disconnect HDPE tubing from Infiltrex 300 inlet.
2. Remove HDPE tubing from the deployment line and coil in a manner that water in the tubing drains into the river.
3. Discard tubing into garbage bag and dispose of properly.
4. Run pump dry for a time until as much water as possible has been expelled from the Infiltrex 300 plumbing system.
5. As soon as convenient, after recovery of the inlet filter, filter cartridges, and XAD columns, potable water should be pumped through the Infiltrex 300 plumbing to flush out the remaining river water. This should be followed by flushing the system with a 10% methyl alcohol solution to sterilize the system. If there is a chance that the Infiltrex 300 will be stores below freezing, it should have a final rinse of pure methanol before being pumped dry so that any remaining liquid will not freeze.

IV. Deployment Locations

HDPE tubing for the collection of water samples via the Infiltrex 300 pump will be deployed at the locations, and at the depths, identified in the FSP.

V. References

Infiltrex 300 Trace Organic Sampling System User's Manual, Axys Environmental Systems, June 2002.

Jeanette Bedard, Customer Service, Axys Technologies, Inc.

Brian Fowler, Customer Service, Axys Technologies, Inc.

Title: Procedure for Deployment and Retrieval of SPMD

Adapted from Environmental Sampling Technologies deployment procedures.

I. Introduction

This procedure describes the equipment and methods to be used to deploy and retrieve semipermeable membrane devices (SPMDs). SPMDs are used as bioaccumulators of lipophilic environmental contaminants in aqueous, sediment, and atmospheric media. These devices mimic biological systems to provide a measure of bioavailable pollutants in both fresh and salt water. The passive transport mechanism is similar to that of fish gills and human lungs. The SPMD, however, unlike the typical biota used in pollution testing, does not metabolize the sequestered compounds, is site-specific, is much easier to extract, and will not overdose and die from the contamination it is supposed to be monitoring.

II. Equipment and Supplies

The following equipment will be needed to deploy and retrieve SPMDs:

1. SPMD tubing: composed of lay flat, low density polyethylene tubing containing a thin film of a pure, high-molecular weight lipid (triolein). The polymer, often thought to be non-permeable, actually consists of transport corridors of less than 10 Å in diameter. These pores allow for the selective diffusion of hydrophobic organic chemicals, which are then sequestered in the lipid phase.

2. 'Spider' Carrier: made of stainless steal, the SPMD tubing is put onto this carrier.

3. Deployment Canister: made of stainless steal, canisters can hold either 2 or 5 SPMD 'spider' carriers depending on the concentrations of contaminants present.

4. Buoy and Anchoring Mechanism: needed to locate SPMDs for retrieval and to hold SPMDs in place during high currents.

5. Boat/Waders: needed to get to measurement location.

6. Personnel protective equipment (PPE): None (Aside from PFDs on boats, waders, and HASP PPE such as protective gloves.)

7. Miscellaneous Supplies – Garbage bags, decontamination supplies (Brushes, Alconox, water) tape measure, field book, digital camera, field application equipment, rubber mallet, deployment buoy and pulley system, 100' tape measure, ice, and GPS.

III. Guidelines

Deployment

1. Prior to SPMD deployment: Acquire sampling locations using GPS and record location. Assess the need to set buoy in place prior to the day of SPMD deployment, if possible. This will permit rapid access to the proposed SPMD location and minimize the amount of equipment carried the day of deployment. At sample locations requiring deployment in the salt wedge (2 feet above the river bottom), a weight (approximately 40 lbs) attached to a buoy will be dropped. From the weight a rope section will be attached so that the SPMD will be positioned at 2 feet above the bottom. From the top of the deployment canister a submerged float will be used to maintain the deployment canister 2 feet above the river bottom.

   For locations where the deployment canister is to be located 2 feet below the surface the canister will be suspended from the buoy (deployed as above). A small weight may be suspended from beneath the canister, if necessary.

For the salt wedge SPMD (brackish/saline water zone) location verify that the location is indeed within the salt wedge at the time of setting the anchoring mechanism, using a salinity meter. Salinity will not be as concentrated as the ocean, and will most likely be around 24 PPT, or less. Relocate as needed.

At locations where less than 5 feet of water is anticipated, anchoring mechanisms will consist of a rebar post driven into the sediment at least 3 feet, if possible. Since these locations are accessible by the public, and vandalism is possible, buoys will not be affixed to the rebar anchor. GPS readings will be taken, when possible.

In the event that GPS readings are not possible, due to trees or other overhead obstructions, measurements to nearby landmarks will be recorded. Compass direction or a description to the location will be recorded.

SPMD deployment devices shall be scrubbed in Alconox, rinsed with tap water, and wrapped in foil in preparation for SPMD deployment.

2. Deploying the SPMDs: Become familiar with the following deployment procedures and prepare for the sequence that follows.

3. Keep SPMDs frozen in their shipping containers until they are transported to the river.

4. Transfer into a cooler and keep the SPMDs on ice until the time of deployment.

5. Travel to the SPMD buoy location, anchor the boat and **turn off the engine**. Check the GPS location and verify that the location has not moved. Different tidal cycles, or wind events, will create an artificial shift in the GPS location due to the position of the buoy. If in doubt, tug on the line to verify that the weight is securely in place. Adjust as necessary. (Shallow locations, especially in tributaries, will be waded to.)

6. After arriving at the deployment site and turning off the engine, generator or any other vapor emitting device. No fuel leaks or oily rags may be aboard the boat.

7. SPMDs will be deployed 2 feet from the surface in the channel of the Passaic River. At locations where there is 4 feet of water, or less, at low tide, SPMDs will be deployed at mid-depth of the anticipated low water depth. At locations where saline and fresh water layers exist two SPMDs will be deployed: one 2’ from the surface and one 2’ from the river bottom. At tributary locations an attempt will be

made to deploy SPMDs in an area where at least two feet of water exists. At Saddle River this will be in the pool formed by the dam, near the USGS gage station. At Third River this will be adjacent to the USGS gage station. At Second River a location upstream of the former USGS gage will need to be identified since low flow depths near the former USGS gage station are less than one foot.

8. Record the temperature of the river water, at the depth that the SPMD will be deployed, to be used later for concentration calculations. Record all Hariba measurements using a calibrated meter.

9. For the salt wedge SPMD (brackish/saline water zone) verify that the location is indeed within the salt wedge at the time of deployment. Salinity will not be as concentrated as the ocean, and will most likely be around 24 PPT.

10. Unscrew the lid on the deployment device. Some lids may give resistance, but the lid will unscrew. Note that there is a threaded rod in the center of the device. The spider carriers will slide into the device on this rod. The spiders can be placed in with the metal plate up or down. Place a twist-tie or other identifying mark on the deployment device indicating the salt wedge (lower) SPMD, so that at the location where two devices are deployed they will not be confused.

11. Begin timing how long it takes to deploy the SPMD: from the time the shipping can is opened until the SPMD enters the water. This time will be used to determine how long the Field Blank SPMD will be exposed to the air. (See Field Blank SPMD.)

12. Work open the gallon can with a church key (screwdrivers, etc. deform and damage the lid).When opening the SPMD shipping cans do not pry them open -- WORK them open carefully. A special opener is included to be used for this. It is imperative that the lid is not damaged or else the seal could be compromised.

    NOTE: All SPMDs will come attached to the spider holder. It may be necessary to scrub the deployment canister free of bio-fouling prior to redeployment of the canister.

13. **While wearing clean gloves**, remove the spider holder from the shipping can by grasping the spider carrier by either the metal plate or center post and lift slightly. Do **not touch the membranes - it could ruin the project**. Note that the there is a metal plate that has flaps that are bent upward. These flaps allow the carrier to slide out of the can diagonally. Gently turn and pull the carrier out of the can taking care not to damage or abrade the membrane. Reseal the shipping can.

14. While holding the spider carrier, slide the carrier into the deployment canister. Again, make sure that the threaded rod runs up through the carrier's center post (tube).

15. If no spacers are called for, and all the carriers are loaded, thread the lid back onto the canister. **CAUTION**- Start threading carefully. If there is resistance and the threads get crossed it could cost more expense in lost time. Please take care!

16. Be sure that the mounting ring on the lid matches with its opposing ring on the device body. These rings must be fastened together. Failure to do so could result in the lid unscrewing and dumping the spiders!

17. DO NOT HANDLE polyethylene membranes. Load the spider carrier(s) as rapidly as possible into deployment canister. Please make sure that the SPMDs are not punctured or abraded by sharp objects.

18. Attach the deployment canister to the weight lead line or buoy suspension line and submerge the canister. Mark the end time for exposure to the atmosphere. Lower the canister down to the predetermined deployment depth.

19. Record GPS coordinates, time of opening the SPMD shipping can, and time of deployment into the river.

20. FIELD BLANKS: One DEPLOYMENT SPMD FIELD BLANK, per deployment day, will be exposed to site atmosphere and conditions in a manner equivalent to the time the sample SPMDs are exposed. This means that if in one day 5 SPMDs are deployed and it takes approximately 5 minutes to deploy each SPMD, the Field Blank SPMD will be exposed for one minute at each location for a total exposure time not to exceed 5 minutes, or the time it takes to install one sample SPMD.

    One RETRIEVAL SPMD FIELD BLANK will be collected in reverse of the deployment field blank during SPMD retrieval.

    To expose each field blank: Open field blank can **CAREFULLY** with the supplied opener. The field blanks do not need to be removed from the cans. After exposure, **CAREFULLY RESEAL**, label, freeze, and document. Use a rubber mallet to replace lids by lightly tapping on the edges of the lid.

Retrieval

1. At arrival note GPS location and river water temperature.

2. When removing your SPMDs from their deployment devices, do the reverse of the above procedures. A rubber mallet is the best tool to use to seal the lids back on the cans in the field. Retrieval Field Blanks will be collected as detailed above, one per retrieval day. Note time that SPMD is out of the river, as described above.

3. Note in the field application the relative amount of bio-fouling on the retrieved SPMD membrane itself. Growth on the deployment canister, which does not impact the SPMD device, is not to be noted. Only in the event that the entire deployment device is obstructed with growth, or a plastic bag, or such, shall it be noted. .Samples should be packed in ice for return to the EST Laboratory, overnight. Several plastic soda bottles of frozen water have been shown to be sufficient for a two day trip.

IV. Deployment Locations

SPMDs will be deployed at the locations, and at the depths, identified in the FSP.

V. Reference

http://est-lab.com/spmd.php (Accessed 7-27-05).

Small Volume Grab Water Samples and Cross-Sectional Composite Sample Procedure

Adapted from information provided by Ultra-Clean Aqueous Sample Collection SOP by Frontier Geosciences

and

Method 1669, Sampling Ambient Water for Trace Metals at EPA Water Criteria Levels, U.S. Environmental Protection Agency, Office of Water Engineering and Analysis Division (4303), July 1996.

I. Introduction

This procedure describes the techniques used to collect multiple small volume water column composite grab samples from up to five locations at pre-determined transects across the Passaic River. Samples will be collected, composited, managed/preserved as required, and shipped to the laboratory on the day of collection. These samples should be collected simultaneously with respect to the other river transects. Samples collected for trace metals analysis will be collected utilizing "clean-hands" procedures described in this SOP and provided in detail in SOP 20 (with EPA Method 1669 attached). If the same pump and sampling tubing is to be used throughout the sample collection process, then the tubing must be handled in accordance with SOP-20: Ultra-Clean Water Sampling Procedures for Mercury.

Care will be taken to prevent contamination of the "clean hands" portion of the sampling.

II. Equipment and Supplies

1. Certified pre-cleaned sample containers large enough to obtain sufficient volumes of water for analysis at each sample site within the river transect. Sample containers must be Teflon, glass, high-density polyethylene (HDPE), low-density polyethylene LDPE, polycarbonate, or other bottles, as appropriate to the analytes of interest. Sample container composition and sizes are presented in the QAPP. The field team will add the appropriate type and volume of preservative to aqueous sample bottles prior to collection. The procedure for adding preservative is provided in the QAPP SOP-2. Samples requiring filtering will be filtered prior to chemical preservation.

2. Pre-packaged, tortuous-path disposable capsule filters for collecting dissolved metals samples. These filters must be provided by laboratory or equivalent clean source, and must be 0.45 micron (μm) in size. The filter must be compatible with the analyte to be filtered (e.g., zero carbon content for carbon analysis; non-protein binding filters for nitrogen). New filters will be used at each transect node during each of the three events for dissolved metals sample collection. (Maximum 15 filters per transect per event.)

3. Peristaltic pump (e.g., ISCO, Masterflex, or equivalent) that either has its own power supply (i.e. internal battery) or can be operated using an external battery (i.e. automobile battery or similar).

4. Silastic medical-grade peristaltic pump tubing (estimate up to 1 foot, to be used with each peristaltic pump head). During filtration the Silastic peristaltic pump tubing will be connected directly to the filter capsule. Prepared for "clean-hands."

5. Teflon or Teflon-lined tubing: used to draw river water for sampling. Prepared for "clean-hands."

6. Pole made of non-contaminating material: to be attached to the end of Teflon or Teflon-lined sample tubing for the collection of water samples when using a peristaltic pump. Add visible foot increments on pole. Prepared for "clean-hands."

7. Braided or monofilament nylon, line: to be used as lanyard to hold inlet of Teflon or Teflon-lined tubing in position while sampling water column.

8. Teflon weight for holding Teflon or Teflon-lined tubing in place. Do not use a lead or metallic weight if collecting metals samples. Prepared for "clean-hands."

9. Composite buckets comprised of non-contaminating material(s) for individual sample analysis. (**Composite buckets are an optional procedure that will not be used for this sampling**.) For duplicate sample collection a certified cleaned sample bottle will be used to collect the sample to be split between the sample and duplicate sample bottles. Similarly, this procedure shall also be used for obtaining the MS and MSD samples. See "Collecting water sample via peristaltic pump" Items Nos. 13 and 14, below, for proper sample volume collection.

10. Buoys: needed to locate water sample locations.

11. Boat/Waders: needed to get to water sample location.

12. Personnel protective equipment (PPE): Shoulder-length gloves constructed from non-contaminating material (i.e. Non-talc polyethylene). Also, PFDs on boats, waders, and HASP required PPE.

13. Nonmetallic coolers

14. Miscellaneous Supplies – Garbage bags, sample Ziploc bags, decontamination supplies (Brushes, Alconox, water) tape measure, field book, digital camera, field application equipment, deployment buoy, 100' tape measure, ice, and GPS.

15. Upon arriving at the sample site, one person from the two-person sampling team is designated as "dirty hands" and the second is designated "clean hands" **FOR SAMPLE COLLECTION FOR ALL METALS ANALYSIS.** All operations involving contact with the sample bottle and transfer of the sample from sample collection device to the sample bottle are handled by the individual designated as "clean hands." "Dirty hands" is responsible for the preparation of the sampler (except the sample container itself), operation of any machinery, and for all other activities that do not involve direct contact with the sample.

16. Hardcopy of EPA Method 1669: (Sampling Ambient Water for Trace Metals at EPA Water Levels, U.S. Environmental Protection Agency, Office of water Engineering and Analysis Division (4303), July 1996.

III. Guidelines

Prior to performing sampling methods:

1. Verify that composite container(s) is decontaminated per SOP 7: Decontamination of Water Sampling Equipment. Refer to SOP 20 for detailed "clean-hands" sample collection for Mercury.

2. Acquire appropriate certified pre-cleaned sample bottles for aqueous samples. For metals analysis, acquire appropriate "clean-hands" prepared sample containers, and pre-preserved "clean-hands" sample containers for filtered samples, from the appropriate laboratory as stipulated in EPA Method 1669. Verify that the sample containers are of the proper construction and volume for the associated analytical procedure.

3. Inspect all sample containers (and bags for "clean-hands") for defects or contamination. Inspect the vials for glass or septum defects (e.g., rim must not have nicks or visible depressions and the septum must not be deformed). Discard if defects are present or containers do not appear clean.

4. To reduce the potential for using incorrect sample containers for a particular analysis, create a checklist of analysis type (method) with regard to container size, material, and preservative required by a particular laboratory. (Also, refer to QAPP)

5. Prior to sampling, verify sampling locations using GPS and record location. Assess the need to set buoy in place prior to the day of sampling, if possible. This will permit rapid access to the proposed whole water sample location and minimize the amount of equipment carried the day of deployment.

Sampling Methodology: Three consecutive sampling events will be performed to collect water samples at each pre-determined location. Specifically, the first water sampling event will be performed one hour after high tide, the second sampling event two hours after the first sampling event, and the third sampling event two hours after the second sampling event.

Whole water samples will be collected at a pre-designated mid-point along the transect. Metals samples will be collected at up to 5 locations along specific river transects and composited. Please refer to FSP Volume 1 for exact water sampling locations. Become familiar with the following procedures and prepare for the sequence that follows.

1. Using a boat, travel to the pre-determined water sample buoy location, anchor the boat at a downstream location and **turn off the engine**. If possible, engine should be shut off at a distance far enough from the sampling point not likely to introduce contamination, and the boat should be manually moved to the sampling point (i.e., wooden oars).

2. Make sure that the bow of the boat is adjacent to the proposed water sample location and that the boat engine exhaust is at the farthest possible location relative to the pre-determined water sample location, preferably downwind. Check the GPS location and verify that the location has not moved. Different tidal cycles, or wind events, will create an artificial shift in the GPS location due to the position of the buoy. If in doubt, tug on the line to verify that the weight is securely in place. Adjust as necessary. (Shallow locations, especially in tributaries, will be waded to.)

3. After arriving at the pre-determined water sample location and shutting-off the boat engine, make sure to shut-off generator or any other vapor emitting device. No fuel leaks or oily rags may be aboard the boat.

4. When wading, position yourself to collect samples upstream from the body. Avoid disturbing sediments in immediate area of sample collection.

5. **Wear appropriate clean Nitrile gloves, or "clean-hands" gloves, as required, at all times.**

6. Measure the water column to determine the maximum depth and the sampling depth.

7. Water samples will be collected at 2 feet below the river surface and/or 2 feet above the river bottom at the predetermined transect site.

Collecting water sample via peristaltic pump:

1. Before putting on wind suits or gloves, the field team removes bags containing the pump, tubing, battery(ies), wind suits, and plastic wrap.

2. Record all Horiba measurements using a calibrated meter.

3. For the salt wedge water sample (brackish/saline water zone) verify that the location is indeed within the salt wedge throughout the time of deployment. Salinity will not be as concentrated as the ocean, and will most likely be around 24 PPT.

2. "Clean hands" and "dirty hands" put on the wind suits and protective gloves.

3. "Dirty hands" removes the pump from its storage bag, and opens the bag containing the Teflon or Teflon-lined tubing.

4. "Clean hands" installs the tubing while "dirty hands" holds the pump.

5. "Clean hands" installs the Teflon or Teflon-lined tubing to a clean pole or to the deconned Teflon weight. Place sufficient amount of string between the Teflon or Teflon-lined tubing so that it the inlet of the Teflon or Teflon-lined tubing is at the desired sampling depth.

6. "Dirty hands" submerges the pole and the end of the Teflon or Teflon-lined sampling tubing to the desired depth.

7. Both "clean hands" and "dirty hands" change gloves. "Clean hands" also puts on shoulder length polyethylene gloves.

8. "Dirty hands" turns the pump on and allows the pump to run for 5-10 minutes or longer to purge the pump and tubing.

9. "Dirty hands" must open the cooler or storage container, remove the double-bagged sample bottle from storage, and unzip the outer bag.

10. Next, "clean hands" opens the inside bag containing the sample bottle, removes the bottle, and reseals the inside bag. "Dirty hands" then reseals the outside bag.

11. "Clean hands" unscrews the cap, and while holding the cap upside-down, discards the dilute acid solution from the bottle into a carboy for wastes.

12a. If the bottle is unpreserved from the laboratory, the sample is collected by rinsing the sample bottle and bottle cap three times and collecting the sample from the flowing stream. "Clean hands" then replaces the cap of the sample bottle.

12b. If the bottle is preserved from the laboratory, the sample is collected directly into the bottle from the flowing stream. "Clean hands" then replaces the cap of the sample bottle.

13. Collection of composite water samples: While pump is running, "clean hands" pumps proportional sample water volumes at each node along the transect directly into the sample bottles from discharge end of Teflon or Teflon-lined tubing from peristaltic pump. With known pump flow rate (timed using a graduated cylinder during the 5 to 10 minute purge period), time the duration of pump filling the sample containers. Therefore, equal volumes of river water from sample locations across river transect will be directed into the sample containers, keeping in mind the volume of water that is needed to fill sample containers that will be submitted to the laboratory (ies) for analysis.

    Example: Three samples will be collected at each transect beginning 1 hour after high tide, and continuing at two hour intervals thereafter until the three samples are obtained. For each of the three sampling periods, 5 locations across each transect are to be collected, where possible. (This will be reduced at tributary locations.) To collect one sample 1/5 of the total volume required for analysis will

be pumped into each sample container, if 5 locations are utilized. At the end of each transect each sample bottle will have been properly filled. "Clean hands" will replace the cap of the sample bottle after the composite water aliquot is added to the bottle.

14. For dissolved (field filtered) metals: "Clean hands" connects the capsule filter to the discharge end of the peristaltic pump. "Dirty hands" starts pump and sends sufficient sample water through the capsule filter to rinse it. "Dirty hands" stops the pump. (Collect this sample water into a container for IDW disposal, if the filter contained laboratory decon fluid.) "Clean hands" places discharge from capsule filter over appropriate open sample bottle (open sample bottle per Items 12a and 12b above) and begins to fill the sample container. Follow Item 13 above for collecting composite water samples. **Note: A new capsule filter must be used at each sample location.**

15. Once the bottle lid has been replaced, "dirty hands" re-opens the outer bag and "clean hands" opens the inside bag, places the bottle inside it, and zips the inner bag.

16. "Dirty hands" zips the outer bag.

17. After each sample is collected, the sample number is documented in the sampling log, and any unusual observations concerning the sample and the sampling are documented.

18. If preservation is required, the sample is taken immediately to the "clean room" where it is acidified with appropriate preservative at this point as described in the QAPP (See SOP 2 for Sample Preservation).

19. Use the same "clean hands" and "dirty hands" methodology mentioned above when handling the sample bottles for the addition of preservatives.

20. Immediately place samples on ice and submit to laboratory.

21. Repeat this process for each consecutive sampling event.

IV. Water Sample Collection Locations

Water samples will be collected at the locations, and at the depths, identified in the FSP.

V. References

Ultra-Clean Aqueous Sample Collection FGS-008.3, Frontier Geosciences, Seattle, WA, November 15, 2001.

Method 1669, Sampling Ambient Water for Trace Metals at EPA Water Criteria Levels, U.S. Environmental Protection Agency, Office of Water Engineering and Analysis Division (4303), July 1996.

Title: Procedure for 5L Niskin Bottle Use

Adapted from information provided by General Oceanics website and interviews with General Oceanics personnel.

I. Introduction

This procedure describes the methods to be used to deploy and retrieve whole water samples using 5L Niskin bottles, or different size Niskin bottles of similar construction and composition. Niskin bottles are non-metallic, free-flushing sampling bottles activated by GO Devil messenger (1000-mg) when individually or serially attached to a cable (string/twine, etc.) The upgraded Niskin bottles have stoppers at each end which are held in place by stainless steel springs and have Teflon coating inside the sampler and on the exterior springs. Additionally, seals are constructed of Viton and air vents and sampling ports are constructed of Teflon. The Niskin bottles are easily used to collect water samples across a river channel transect provided no field sample preparation is required. Generally, a composite of multiple samples from the 5L Niskin bottles are transferred into a 20L stainless steel POP container, which is placed on ice and transported directly to the analytical laboratory.

II. Equipment

The 5L Niskin bottles have the following components:

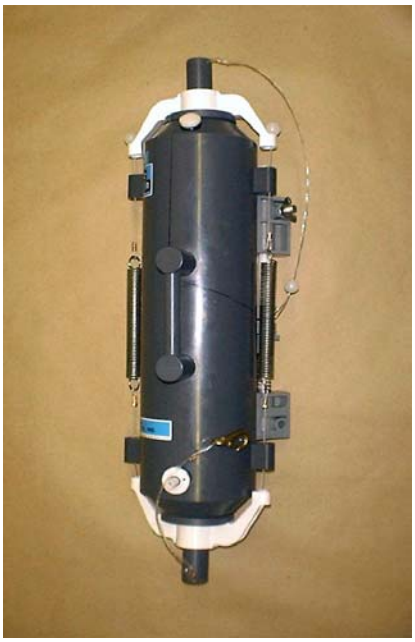


Photo of Niskin-X External Spring Sampler

1. Non-Metallic construction of PVC tube section. Teflon coating is added to interior of PVC tube.
2. PVC end stoppers (two each). Teflon coating is added to interior portions of end stoppers.
3. PVC handles
4. Stainless steel cable clamps with external springs
5. Teflon-coated Deldrin stopcocks
6. Teflon air vent screw
7. Teflon drain valve
8. Viton o-rings
9. Nylon monofilament lanyards
10. End closure stopper with spherical section sealing surface held firmly against o-ring seal by external stainless springs.
11. GO Devil (1000 mg) messenger

III. Supplies:

1. Nylon rope (or similar rope/line) having a diameter fitting inside the center of the GO Devil messenger.
2. Buoys: needed to locate water sample locations.

3. Boat/Waders: needed to get to measurement location.

4. Personnel protective equipment (PPE): None (Aside from PFDs on boats, waders, and HASP PPE such as protective gloves.)

5. Miscellaneous Supplies – Garbage bags, decontamination supplies (Brushes, Alconox, water) tape measure, field book, digital camera, field application equipment, rubber mallet, deployment buoy and pulley system, 100' tape measure, ice, and GPS.

IV. Guidelines

1. Prior to 5L Niskin bottle deployment: Acquire sampling locations using GPS and record location. Assess the need to set buoy in place prior to the day of 5L Niskin bottle deployment, if possible. This will permit rapid access to the proposed whole water sample location and minimize the amount of equipment carried the day of deployment.

2. Using non-contaminating markers or tape, place 1-foot marks on rope/twine attached to the 5L Niskin bottles for accurate depth placement for the collection of whole water samples. Attach rope/twine per manufacturer's specifications to attachment point in 5L Niskin bottle. Be sure to thread GO Devil messenger device onto rope/twine prior to attaching rope/twine to 5L Niskin bottle.

3. Keep stoppers closed on both ends of clean (deconned) 5L Niskin bottle until it is ready for deployment. Clean (deconned) 5L Niskin bottles should also be kept in a plastic bag until ready for use.

Deploying and Retrieving the 5L Niskin bottles: Become familiar with the following deployment procedures and prepare for the sequence that follows. 5L Niskin bottles will be required for collecting whole (total) water.

1. Travel to the pre-determined water sample buoy location, anchor the boat at a down current location and **turn off the engine**. Make sure that the bow of the

boat is adjacent to the proposed water sample location and that the boat engine is at the farthest possible location relative to the pre-determined water sample location, preferably downwind. Check the GPS location and verify that the location has not moved. Different tidal cycles, or wind events, will create an artificial shift in the GPS location due to the position of the buoy. If in doubt, tug on the line to verify that the weight is securely in place. Adjust as necessary. (Shallow locations, especially in tributaries, will be waded to.)

4. After arriving at the deployment site and shutting-off the boat engine, make sure to shut-off generator or any other vapor emitting device. No fuel leaks or rags may be aboard the boat.

5. Obtain total depth of water column using a weighted graded device (*e.g.* graded nylon string with weight.

6. 5L Niskin bottles will be deployed 2 feet from the surface in the channel of the Passaic River. At locations where saline and fresh water layers exist of the same 5L Niskin bottle will be deployed: one collection 2' from the surface and one collection 2' from the river bottom.

7. Record the temperature of the river water, at the depth that the 5L Niskin bottles will be deployed, to be used later for concentration calculations. Record all Horiba measurements using a calibrated meter.

8. For the salt wedge water sample (brackish/saline water zone) verify that the location is indeed within the salt wedge at the time of deployment. Salinity will not be as concentrated as the ocean, and will most likely be around 24 PPT.

9. **Wear clean gloves while performing any tasks requiring contact with 5L Niskin bottles, related sample containers, and rope/twine.**

10. Open 5L Niskin bottles by tuning open both end stoppers and placing attached nylon monofilament lanyards between side pegs. The nylon monofilament line will automatically rest against the side of the peg that is away from the end stopper from which it is attached. **Be sure that the drain valve is in a closed position!**

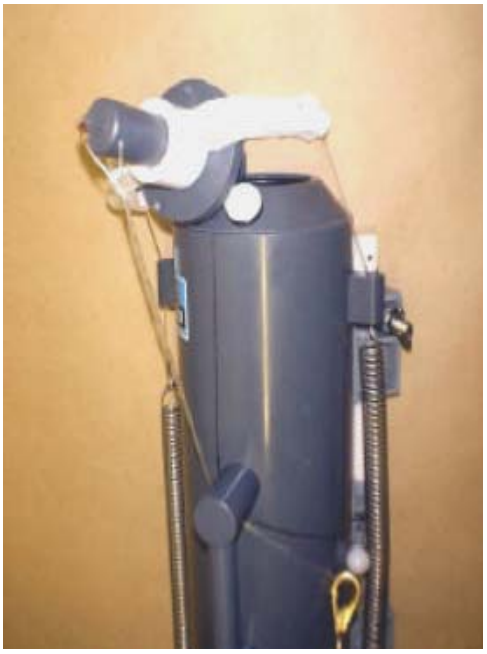


Photo of open end of 5L Niskin bottle.

11. While holding rope/twine attached to 5L Niskin bottle, gently place 5L Niskin bottle into river and slowly lower to the appropriate depth for sample collection. When at the desired sample depth (using graded rope/twine), allow water to flush through the Niskin 5L bottle for a minimum of 10 seconds. This will allow the interior of the 5L Niskin bottle to rinse and allow material from the water surface which may have been lowered at depth by the 5L Niskin bottle to leave the vicinity of the 5L Niskin bottle. **Be sure to keep the Go Devil messenger in hand at a position above the water surface while each 5L Niskin bottle is lowered.**

12. Record GPS coordinates and time of deployment of the 5L Niskin bottles into the river.

13. When at the desired sampling depth, drop the Go Devil messengers simultaneously into the water toward the 5L Niskin bottle. The Go Devil

messengers will contact a trip mechanism on each 5L Niskin bottle, if two are deployed simultaneously, which will then close both stoppers.

14. Gently pull the 5L Niskin bottle(s) up from the water column using the rope/twine. Separate 5L whole water column samples will be collected four times throughout the duration of the Infiltrex 300 water sample filtering process at the particular station for both total (Niskin bottle) and field filtered (INFILTREX - without XAD column) water samples.

15. Making sure that the boat motor is at the farthest possible location from water sample location, start the boat and slowly and carefully bring the boat anchor(s) back to the boat. Make all attempts possible not to increase the water column turbidity**. Gently rinse sediment off of anchor before bringing it aboard.**

16. Slowly maneuver the boat at a down current position from the pre-determined water sample to transport water sample back to shore.

17. Whole Water Samples: Immediately place water sample from 5L Niskin bottle used for total analysis directly into a clean (deconned) 20L stainless steel POP container. Securely attach lid on the 20L POP container and place the 20L POP container directly on ice. Be sure to wear proper gloves and PPE throughout the process.

18. Filtered Water Samples: Lower a Teflon, or Teflon lined, tubing to the elevation required for sample collection at the location. Filter the water using the INFILTREX using it in a configuration without the XAD column. Therefore the INFILTREX will be operated for field filtering particulates only. Turn on pump and draw sample from river through the filter and pump and discharge the filtered sample into a clean (deconned) 20L stainless steel POP container. Securely attach lid on the 20L POP container and place the 20L POP container directly on ice. Be sure to wear proper gloves and PPE throughout the process.

19. Follow deconning SOPs for the 5L Niskin bottles prior to retrieving additional water samples from a different sampling location. Note: The same Niskin bottle may be used to obtain fresh and salt water samples at the same sampling location.

V. Deployment Locations

5L Niskin bottles will be deployed at the locations, and at the depths, identified in the FSP.

VI. References

http://www.generaloceanics.com (Accessed 8-10-05)

Rick Wood, General Oceanics, Inc.

Ultra-Clean Water Sampling Procedures for Mercury

Adapted from information provided by Ultra-Clean Aqueous Sample Collection SOP by Frontier Geosciences

and

Method 1669, Sampling Ambient Water for Trace Metals at EPA Water Criteria Levels, U.S. Environmental Protection Agency, Office of Water Engineering and Analysis Division (4303), July 1996.

I. Introduction

This procedure describes the techniques used to obtain water samples for mercury analysis using Ultra-Clean Water Sampling Procedures. Mercury will be collected from up to two depth increments at up to five locations at pre-determined transects across the Passaic River. Samples will be collected to represent the cross section, managed as required, and shipped to the laboratory on the day of collection. These samples should be collected simultaneously with respect to each other.

II. Equipment and Supplies

1. Laboratory-supplied sample containers large enough to obtain sufficient volumes of water for analysis at each sample site within the river transect. Sample containers must be of Fluoropolymer or borosilicate glass construction with fluoropolymer or fluoropolymer-lined caps, since mercury vapors can diffuse in or out of other materials, resulting in contamination or low-biased results. All materials that will directly or indirectly contact the sample must be cleaned at a laboratory or cleaning facility using detergent, mineral acids, and reagent water as described in EPA Method 1631 for Mercury. The laboratory or cleaning facility is responsible for generating an equipment blank indicating that the sample containers and sampling equipment are free of trace metals contamination before they are shipped to the field team. An acceptable blank for mercury is free from contamination below the minimum level (ML) of 0.0005 micrograms per liter (µg/L). After cleaning, all sample containers are filled with a weak acid solution, individually double bagged, and shipped to the sampling site. All sampling equipment is also bagged for storage and shipment.

2. Carboy or other clean sample container filled with reagent water. For use with the collection of equipment blanks. The reagent water is to be handled the same as the

sampling containers. At least one field blank should be processed per site, or one every 10 samples, whichever is more frequent.

3. Peristaltic pump (e.g., ISCO, Masterflex, or equivalent): Either has its own power supply (i.e. internal battery) or can be operated using an external battery (*i.e.* automobile battery or similar).

4. Silastic medical-grade peristaltic pump tubing (estimate up to 1 foot to be used with each peristaltic pump head). Small segments of this tubing can also be used to join Teflon or Teflon-lined tubing to flow-thru cells, in-line sample filters, etc.

5. Teflon or Teflon-lined tubing: used to draw river water for sampling.

6. Pole made of non-contaminating material: to be attached to the end of Teflon or Teflon-lined sample tubing for the collection of water samples when using a peristaltic pump. Add visible foot increments on pole.

7. Laboratory–supplied grab sampling device: To be used as an alternative for collecting shallow water samples.

8. Braided or monofilament nylon, line: to be used as lanyard to hold inlet of Teflon or Teflon-lined tubing in position while sampling water column.

9. Teflon weight for holding Teflon or Teflon-lined tubing in place. Do not use a lead or metallic weight if collecting metals samples. Prepared for "clean-hands."

10. Field-portable glove-bag: I2R, Model R37-37H (nontalc), or equivalent. Additionally, a portable glove-box may be constructed with a non-metallic (PVC or other suitable material) frame, and frame cover made of an inexpensive, disposable, non-metallic material (*e.g.*, thin-walled polyethylene bag).

11. Storage bags: clean zip type, non-vented, polyethylene type (various sizes).

12. Plastic wrap: clean, colorless polyethylene.

13. Cooler: clean nonmetallic with white interior.

14. Ice or chemical refrigerant packs.

15. Wind suit: unlined, long-sleeved consisting of pants and jacket constructed of nylon or other synthetic fabric.

16. If boat is used, it is recommended to be of non-metallic construction.

17. Buoys: needed to locate water sample locations.

18. Boat/Waders: needed to get to water sample location.

19. Personnel protective equipment (PPE): Shoulder-length gloves constructed from non-contaminating material (*i.e.* polyethylene). Also, PFDs on boats, waders, and HASP PPE such as protective gloves.

20. Miscellaneous Supplies – Garbage bags, decontamination supplies (Brushes, Alconox, water) tape measure, field book, digital camera, field application equipment, rubber mallet, deployment buoy and pulley system, 100' tape measure, ice, and GPS.

21. Hardcopy of EPA Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Levels, U.S. Environmental Protection Agency, Office of water Engineering and Analysis Division (4303), July 1996.

III. Guidelines

Prior to performing sampling methods:

1. Acquire appropriate preserved sample containers from the appropriate laboratory. Verify that the sample containers are of the proper construction and volume for the associated analytical procedure.

2. Inspect all sample containers for defects or contamination. Discard if defects are present or containers do not appear clean.

3. Prior to sampling, verify sampling locations using GPS and record location. Assess the need to set buoy in place prior to the day of sampling, if possible. This will permit rapid access to the proposed whole water sample location and minimize the amount of equipment carried the day of deployment.

Sampling Methodology: Become familiar with the following procedures and prepare for the sequence that follows.

1. Using a boat, travel to the pre-determined water sample buoy location, anchor the boat at a downstream location and **turn off the engine**. If possible, engine should be shut off at a distance far enough from the sampling point not likely to introduce contamination, and the boat should be manually moved to the sampling point (*i.e.*, wooden oars).

2. Make sure that the bow of the boat is adjacent to the proposed water sample location and that the boat engine is at the farthest possible location relative to the pre-determined water sample location, preferably downwind. Check the GPS location and verify that the location has not moved. Different tidal cycles, or wind events, will create an artificial shift in the GPS location due to the position of the buoy. If in doubt, tug on the line to verify that the weight is securely in place. Adjust as necessary. (Shallow locations, especially in tributaries, will be waded to.)

3. After arriving at the pre-determined water sample location and shutting-off the boat engine, make sure to shut-off generator or any other vapor emitting device. No fuel leaks or rags may be aboard the boat.

4. When wading, position yourself to collect samples upstream from the body. Avoid disturbing sediments in immediate area of sample collection.

5. Upon arriving at the sample site, one person from the two-person sampling team is designated as "dirty hands" and the second is designated "clean hands." All operations involving contact with the sample bottle and transfer of the sample from sample collection device to the sample bottle are handled by the individual designated as "clean hands." "Dirty hands" is responsible for the preparation of the sampler (except the sample container itself), operation of any machinery, and for all other activities that do not involve direct contact with the sample.

The following two methods may be used for the collection of the water sample for mercury:

Collecting water sample via grab sampling device:

1. The sampling team puts on gloves and wind suits. Ideally, a sample bottle will have been pre-attached to the sampling device in a Class 100 clean room at the

laboratory. If it is necessary to attach a bottle to the device in the field, "clean hands" performs this operation inside the field-portable glove bag.

2. "Dirty hands" removes the sampling device from its storage container and opens the outer polyethylene bag.

3. "Clean hands" opens the inside polyethylene bag and removes the sampling device.

4. "Clean hands" changes gloves.

5. "Dirty hands" submerges the sampling device to the desired depth and pulls the fluoropolymer cord to bring the seal plate into the middle position so that water can enter the bottle.

6. When bottle is full, (*i.e.*, when no more air bubbles appear), "dirty hands" pulls the bottle out of the collar, unscrews the bottle from the sealing device, and caps the bottle. "Clean hands" and "dirty hands" then return the bottle to its double-bagged storage by having "dirty hands" re-open the outer bag and "clean hands" opens the inside bag, places the bottle inside it, and zips the inner bag. "Dirty hands" then zips the outer bag.

7. Closing mechanism- "Clean hands removes the closing mechanism from the body of the grab sampler, rinses the device with reagent water, places it inside a new clean plastic bag, zips the bag, and places the bag inside an outer bag by "dirty hands." "Dirty hands" zips the outer bag and places the double-bagged closing mechanism into the equipment storage box.

8. Sampling device- "Clean hands" seals the large inside bag containing the collar, pole, and cord and places the bag into a large outer bag held by "dirty hands." "Dirty hands" seals the outside bag and places the double-bagged sampling device into the equipment storage box.

9. After each sample is collected, the sample number is documented in the sampling log, and any unusual observations concerning the sample and the sampling are documented.

10. Immediately place samples on ice and submit to laboratory.

Collecting water sample via peristaltic pump:

1. Before putting on wind suits or gloves, the field team removes bags containing the pump, tubing, battery(ies), wind suits, and plastic wrap.

2. "Clean hands" and "dirty hands" put on the wind suits and protective gloves.

3. "Dirty hands" removes the pump from its storage bag, and opens the bag containing the Teflon or Teflon-lined tubing.

4. "Clean hands" installs the tubing while "dirty hands" holds the pump.

5. "Clean hands" installs the pump to a clean pole (pre-cleaned as prescribed in EPA Method 1631 for Mercury).

6. "Dirty hands" submerges the pole and end of the Teflon or Teflon-lined sampling tubing to the desired depth

7. Both "clean hands" and "dirty hands" change gloves. "Clean hands" also puts on shoulder lengthy polyethylene gloves.

8. "Dirty hands" turns the pump on and allows the pump to run for 5-10 minutes or longer to purge the pump and tubing.

9. "Dirty hands" must open the cooler or storage container, removed the double-bagged sample bottle from storage, and unzip the outer bag.

10. Next, "clean hands" opens the inside bag containing the sample bottle, removes the bottle, and reseals the inside bag. "Dirty hands" then reseals the outside bag.

11. "Clean hands" unscrews the cap, and while holding the cap upside-down, discards the dilute acid solution from the bottle into a carboy for wastes.

12. If the sample bottle has no preservative from the laboratory, the sample is collected by rinsing the sample bottle and bottle cap three times and collecting the sample from the flowing stream. If the sample bottle has preservative from the laboratory, it is filled directly from the flowing stream and not rinsed. Because of the risk of contamination, it is recommended that samples of mercury be shipped **unfiltered** by overnight courier and filtered when received at the laboratory. If preservation is required, the sample is acidified with appropriate preservative at this point. Preservation must be performed in the glove bag or in a designated

clean area, with gloved hands, as rapidly as possible to preclude particulates from contaminating the sample.

13. "Clean hands" then replaces the cap of the sample bottle.

14. Once the bottle lid has been replaced, "dirty hands" re-opens the outer bag and "clean hands" opens the inside bag, places the bottle inside it, and zips the inner bag.

15. "Dirty hands" zips the outer bag.

16. After each sample is collected, the sample number is documented in the sampling log, and any unusual observations concerning the sample and the sampling are documented.

17. Immediately place samples on ice and submit to laboratory.

IV. Water Sample Collection Locations

Water samples will be collected at the locations, and at the depths, identified in the FSP.

V. References

Ultra-Clean Aqueous Sample Collection FGS-008.3, Frontier Geosciences, Seattle, WA, November 15, 2001.

Method 1669, Sampling Ambient Water for Trace Metals at EPA Water Criteria Levels, U.S. Environmental Protection Agency, Office of Water Engineering and Analysis Division (4303), July 1996.

Method 1631 Revision E: Mercury in Water by Oxidation, Purge Trap, and Cold Vapor Atomic Fluorescence Spectronomy, US Environmental Protection Agency, Office of Water Engineering and Analysis Division (4303), August 2002.

Title: Procedure for use of Horiba for Measuring Water Parameters

Adapted from Horiba Ltd U-10 Water Quality Checker Instruction Manual.

I. Introduction

This procedure describes the equipment and methods to be used collect and process water quality data using a Horiba U-10 Water Quality Checker. The Horiba U-10 Water quality checker can be used to collect conductivity, turbidity, salinity, temperature, dissolved oxygen, and pH in water.

II. Equipment and Supplies

The following equipment is required to collect and store water quality data:

1. Horiba U-10 Main Unit which contains:
   A. Cover for printer port.
   B. Printer Post.
   C. LCD Readout.
   D. Keypad.
   E. Cable Connector.
2. Horiba U-10 Cable
3. Horiba U-10 Probe which contains:
   A. Dissolved Oxygen (DO) Sensor.
   B. Conductivity Sensor.
   C. Reference Sensor.
   D. Temperature Sensor.
   E. pH Sensor.
   F. Turbidity Sensor.
   G. Probe Guard.
4. Horiba U-10 Sample/Calibration Beaker.

5. Laptop computer with instrument interface software, field sampling data collection application.
6. 9-Volt battery for the instrument.
7. Vessel with DGPS navigation system.
8. Personal safety gear: including personal flotation devices (PFDs), waterproof outer wear, steel toed boots (waterproof if rough seas or weather), and mobile phone.
9. Calibration materials/solutions
10. Station logs, indelible markers/pens (*e.g.*, Sharpies™).
11. Horiba U-10 Instruction Manual.

III. Guidelines

1. Be sure to read and become familiar with the Horiba U-10 Instruction Manual.

2. Prior to field use, inspect probes on the bottom of the Horiba U-10 to verify that no cracks, discolorations, etc, exist on or around the probes.

3. Calibrate the Horiba U-10 per the manufacture's specifications (see Section 3, Horiba U-10 Instruction Manual). Keep in mind that pH and DO values change with temperature. Note pre calibration values, and instrument voltage settings post-calibration values in field application or instrument logbook. Calibrate Horiba U-10 as frequently as recommended by the manufacturer.

4. Clean the Horiba U-10 sample/calibration beaker and probes as specified in SOP-7: Decontamination of Water Sampling Equipment. Be sure to rinse the probes thoroughly with water. This should be performed prior to arriving at each sample location.

5. Turn the power for the Horiba U-10 to "On." The Horiba U-10 will be in the measure "MEAS" mode. After approximately 2 seconds, the Horiba U-10 readout will change to show that a new measurement is being made. Use the "SELECT" key to toggle the upper cursor to the parameter needed.

6. Prior to collecting water samples for laboratory analysis, place river water from the pump or other collection device/method directly into the Horiba U-10 sample/calibration beaker. Fill beaker to level specified by the manufacturer.

7. Place the Horiba U-10 probes directly into the Horiba U-10 sample/calibration beaker. All six parameters (DO, conductivity, temperature, pH, turbidity, and salinity) are measured instantly. Use the "SELECT" key to toggle the upper cursor to the parameter needed. These parameters may be stored in memory, printed-out, or viewed one-by-one on the readout. Note: never drop or throw the Horiba U-10 probe into the water; it can be damaged beyond repair by unnecessary rough handling.

8. After either collecting parameter measurements, discard the water in the Horiba U-10 sample/calibration container back into the river. Immediately clean the Horiba U-10 sample/calibration container per SOP-7: Decontamination of Water Sampling Equipment. Be sure to rinse the probes thoroughly with water.

9. Fill the Horiba U-10 sample/calibration beaker with deionized or equivalent water and fit the probe over it.

10. All data collected from the Horiba U-10 are recorded in the field computer. The data is stored in the instrument, and transferred periodically during the survey. Upon completion of sampling at one location, all ancillary data (*e.g.* date, time, position, etc.) is entered into the field application. The field application prompts the user for the required information and also automatically uploads daily weather and tidal conditions from the NOAA website. Blank field log sheets to record information manually will be provided in case difficulties with data entry into the field computer are encountered.

11. Water quality data should be reviewed as often as is practical to assure results are within expected ranges and the instrument is operating properly. Graphical plots or spreadsheet average/minimum/maximum review are suitable methods. If data is suspect, the discrepancy is noted in the field application, and the meter should be re-calibrated as soon as practible.

12. After a successful profile, enter prompted information into the field application:
    - Date
    - Time of water column profile
    - Actual coordinates of the sample location
    - Water depth (ft)
    - Instrument Serial Number
    - Sensor data collected
    - Observations

13. At the end of each day, an electronic copy (disk) of the field application that includes the information recorded for each profile collected that day will be created as a back up of that day's project information. A copy of the signed field log form will be maintained by the field team leader.

IV. Reference

Horiba U-10 Water Quality Checker Instruction Manual, Horiba Ltd., November 1991.

Title: Management and Disposal of Investigation Derived Waste

I. Introduction

This procedure describes the methods used to manage, store, and dispose of investigation derived waste produced during environmental sampling for the Lower Passaic River Restoration Project. The procedures specifically address sediments, soils, water, solvents, and Personal Protective Equipment (PPE) waste generated from collection of sediment, soil and water samples and equipment decontamination.

This SOP does not address radioactive decontamination, PPE for radioactive waste, or disposal of radioactive contaminated waste material.

II. Definitions

PSO: Project Safety Officer
IDW: Investigation derived waste
PPE: Personal Protective Equipment

III. Equipment and Supplies

The purchase, maintenance, and use of the supplies and equipment listed below are the responsibility of the Project Safety Officer (PSO) and Processing Facility Manager.

The following equipment and supplies will be used to collect and dispose of investigation derived waste:

1. Waste Storage and Disposal Containers

   A. 30- or 55-gallon drums for solid and liquid wastes, including 30 gallon plastic drums for solids, and sealed top drums with screw-plug openings for liquids. As for liquid storage, steel (6D) drums will be used in the storage of solvent waste. For aqueous organic and acid waste, polylined (17E) drums will be used for storage.

2. Transferring Equipment

   A. Plastic safety funnels with brass or plastic screens and vents.
   B. Hand pump/siphon with Teflon or tygon tubing.
   C. Tools: screwdriver, drum plug wrench, and brass pliers.
   D. Drum dolly.

3. PPE

   A. Disposable Tyvex coveralls and/or lab coats.
   B. Disposable plastic gloves (nitrile, butyl rubber, or Viton).
   C. Respirator and cartridges (consult PSO to determine PPE requirements).
   D. Shoe covers (rubber or Tyvek).

4. Spill Cleanup Equipment and Supplies

   A. Spill absorbent (Vermiculite or Speedidry™).
   B. Broom, foxtail and dustpan.
   C. Shovel.
   D. Paper towels.
   E. 85-gallon overpack drum.
   F. Manual drum pump (same as pump in 'Item 2. Transferring Equipment').

5. Labels and Logs**:** A supply of labels and log sheets that are referred to in this SOP are to be kept on site in an easily accessible location, described in the Work Plan. Additional logs will be obtained from the Processing Facility Manager.

6. Digital camera to document IDW management.

IV. Guidelines

The following procedures will be used to store, manage, and transport IDW:

1. Waste Disposal: IDW is held in the appropriate designated storage area until approval for disposal is granted. After the PSO and Processing Facility Manager receive documentation on the level of contamination in the waste, they will assist the Project Manager in deciding whether the waste is suitable for disposal in a landfill, or must be discarded in a hazardous waste stream.

2. Solid Waste

   A. Solid waste is to be transferred into an air-tight, 30 gallon open top drum.

   B. The lid is to be removed from the collection container and the contents placed into the storage drum.

   C. Once the transfer has been completed, the lid and sealing ring are to be replaced on the storage drum.

   D. The transfer will be recorded on the waste transfer log, and this log will be placed in a location described in the Work Plan for reference.

3. Liquid Waste

   A. All solvents used for decontamination must be captured and disposed of in appropriate, labeled, aqueous waste containers. Liquids collected into the chemical waste container must be discarded in an appropriate waste stream. Care must be taken not to mix substances that will react with each other. If there is any question concerning compatibility, the PSO or Project Manager should be contacted prior to taking action. A record of the type, relative amount, and hazard associated with each substance added must be kept on the hazardous waste log. This log must be attached to the satellite container. Waste may be temporarily stored, if properly labeled, prior to satellite container introduction. The waste contents in these temporary storage containers must be introduced into an approved satellite container by the end of every working day.

   B. Staff performing decontamination procedures need to wear appropriate PPE, gloves (*e.g.*, nitrile) and eye protection. Care must be taken in cleaning not to allow contact of cleaning solutions with clothing as much as possible. If circumstances dictate contact will occur (*e.g.*, high pressure washing, splashing, high wind), waterproof outer clothing must be worn (*e.g.*, foul weather gear or rain gear).

C. Liquid waste is to be transferred into an air-tight, 55-gallon, screw-cap drum. When a new drum is started, the larger cap is unscrewed with the drum plug wrench. The safety vent is screwed in and the cap tightened by hand.

4. PPE

A. PPE are to be transferred into air-tight, 30 gallon open top drums.

B. The lid is to be removed from the collection container and the contents placed into the storage drum.

C. Once the transfer has been completed, the lid and sealing ring will be replaced on the storage drum.

5. Project Safety Officer: Along with the Processing Facility Manager, the PSO is responsible for overseeing IDW collection and management and arranging for IDW to be disposed of off site in accordance with local, state, and federal Regulations. The responsibilities of the PSO and Processing Facility Manager include:

A. Packaging and labeling of containers.

B. Arranging for waste removal.

C. Maintaining manifest records and tracking the manifest until its signed and returned.

D. Conducting weekly inspections of the waste area.

E. Ensuring that the proper waste-handling materials and personal protective equipment are available and adequate (*e.g.*, gloves, coveralls, goggles, respirators and cartridges, boots, funnels, pumps).

F. Maintaining emergency spill response equipment.

Title: Procedure for Secchi Disk Depth (Transparency) Measurement

I. Introduction

This procedure describes the equipment and methods to be used to collect Secchi Disk depth (transparency) measurements for the Lower Passaic River Restoration Project. Transparency can be measured quickly and easily, but is sensitive to light intensity, reflection, and turbidity.

II. Equipment and Supplies

The following equipment will be needed to collect transparency measurements using the Secchi Disk:

1. Secchi Disk: named after Pietro Secchi, who first used it in 1865 to measure the transparency of the Mediterranean Sea. The disk is made of rigid plastic or metal, but the details of its design are variable. It may be 20 to 30 cm or even larger in diameter and is usually painted white. Alternatively, it may be painted with black and white quadrants. The disk is suspended from a calibrated line, or attached to a calibrated rod. Earlier models, pictured below, have an attached weight. Modern models need no weights and are typically made of acrylic with a center hook eye and rope.

   A 200 mm (7-7/8") plastic Secchi Disk will be used. It will have four quadrants, two white and two black. The disk will be attached via a hook eye to 20 meters of 1/8" diameter line on a Styrofoam form that will float if dropped in the water.

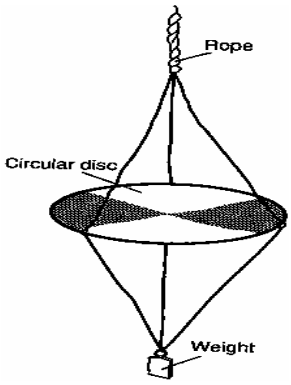


Figure 1: Secchi Disk

2. Boat or waders: to get to the measurement location.

3. Personnel protective equipment (PPE): none (However, PFD required for boat or when wading. HASP PPE required for measurements conducted in contaminated waters.)

4. Miscellaneous Supplies – Garbage bags, decontamination supplies (Paper towels and Alconox), measuring tape, field book, field application equipment, and GPS.

III. Guidelines

1. Try not to not make measurements early in the morning or late in the afternoon because sun glare may distort observations. Wear polarized sunglass if this reduces the surface reflection and improves visibility of the disk.

2. Lower the Secchi Disk through a shaded area of water surface, where possible.

3. As the disk is lowered, note the depth at which it just disappears from view.

4. Lower the disk a little further, then raise it and note the depth at which it reappears.

5. Record the average of the two depth readings as the Secchi Disk transparency. The report must also state the diameter of the disk (200 mm) and the four quadrant pattern on the upper surface of the disk.

IV. References

Lind, O.T. 1979. Handbook of common methods in Limnology. C.V. Mosby Co. Saint Louis.190 pp.

Water Quality Monitoring - A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes. © 1996 UNEP/WHO. (http://www.who.int/docstore/water_sanitation_health/wqmonitor/ch08.htm#b2-6.2%20Transparency accessed 7-27-05).

Place Holder for SOP 24 Eckman Dredge